NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

OBSERVING THE LOSS OF SITUATIONAL AWARENESS AND TACIT KNOWLEDGE DURING PERSONNEL CHANGE-OVER IN A U.S. COAST GUARD COMMAND AND CONTROL ENVIRONMENT

by

Andrew D. De George

September 2012

Thesis Advisor: Mark E. Nissen
Second Reader: Matthew R. McGlynn

Approved for public release; distribution is unlimited

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE		*Form Approved OMB No. 0704–0188*

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202–4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704–0188) Washington DC 20503.

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE September 2012	3. REPORT TYPE AND DATES COVERED Master's Thesis
4. TITLE AND SUBTITLE Observing the Loss of Situational Awareness and Tacit Knowledge during Personnel Change-Over in a U.S. Coast Guard Command and Control Environment		5. FUNDING NUMBERS
6. AUTHOR(S) Andrew D. De George		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943–5000		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A		10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB Protocol number: NPS.2012.0030-IR-EP7-A

12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited	12b. DISTRIBUTION CODE A

13. ABSTRACT (maximum 200 words)

A Coast Guard Command & Control (C2) Command Center (COMCEN) is responsible for managing missions, planning and executing operations, and coordinating case or incident responses. The success of the C2 COMCEN depends on the quality of situational awareness—a predominant requirement for making decisions and taking action. A key element to accomplish situational awareness is the evolution of rich and powerful tacit knowledge produced by COMCEN personnel. The creation of tacit knowledge is the result of accumulating information, generating explicit knowledge, and combining with personal experience. Experts describe tacit knowledge as a progression of knowledge maturity under the influences external organizational culture as it travels through knowledge life-cycle phases.

Management suspects that during the course of the watch and the watch-relief process, knowledge is vulnerable to constraints or degradation, thus affecting the C2 COMCEN's ability to generate and sustain quality situational awareness. This study examines a C2 COMCEN environment and watch processes by making observations and conducting interviews for understanding influences of knowledge quality. The study also examines the watch environment, where knowledge originates, and how well knowledge flows. The literature review aids the study by providing knowledge research and studies from leading experts in the knowledge field.

14. SUBJECT TERMS Situational Awareness, Knowledge, Command & Control, Command Center, knowledge life cycle.		15. NUMBER OF PAGES 107
		16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UU

NSN 7540–01–280–5500

Standard Form 298 (Rev. 2–89)
Prescribed by ANSI Std. 239–18

THIS PAGE INTENTIONALLY LEFT BLANK

OBSERVING THE LOSS OF SITUATIONAL AWARENESS AND TACIT KNOWLEDGE DURING PERSONNEL CHANGE-OVER IN A U.S. COAST GUARD COMMAND AND CONTROL ENVIRONMENT

Andrew D. De George
Lieutenant Commander, United States Coast Guard
B.S., Touro University, 2007
M.S., National Graduate School, 2010

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

from the

**NAVAL POSTGRADUATE SCHOOL
September 2012**

Author: Andrew D. De George

Approved by: Mark E. Nissen
                     Thesis Advisor

                     Matthew R. McGlynn
                     Second Reader

                     Dan C. Boger
                     Chair, Department of Information Sciences

iii

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

A Coast Guard Command & Control (C2) Command Center (COMCEN) is responsible for managing missions, planning and executing operations, and coordinating case or incident responses. The success of the C2 COMCEN depends on the quality of situational awareness—a predominant requirement for making decisions and taking action. A key element to accomplish situational awareness is the evolution of rich and powerful tacit knowledge produced by COMCEN personnel. The creation of tacit knowledge is the result of accumulating information, generating explicit knowledge, and combining with personal experience. Experts describe tacit knowledge as a progression of knowledge maturity under the influences external organizational culture as it travels through knowledge life-cycle phases.

Management suspects that during the course of the watch and the watch-relief process, knowledge is vulnerable to constraints or degradation, thus affecting the C2 COMCEN's ability to generate and sustain quality situational awareness. This study examines a C2 COMCEN environment and watch processes by making observations and conducting interviews for understanding influences of knowledge quality. The study also examines the watch environment, where knowledge originates, and how well knowledge flows. The literature review aids the study by providing knowledge research and studies from leading experts in the knowledge field.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

LIST OF FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

AOR	Area of Responsibility
CDO	Command Duty Officer
COMCEN	Communications Center
D11	Commander Coast Guard District Eleven
DHS	Department of Homeland Security
DoD	Department of Defense
IT	Information Technology
KM	Knowledge Management
MDA	Maritime Domain Awareness
OU-LE	Operational Unit – Law Enforcement controller
OU-SAR	Operational Unit – Search and Rescue controller
RCC	Rescue Coordination Center
SAR	Search and Rescue
SECI	Socialization, Externalization, Combination, and Internalization)
SMC	SAR Mission Coordinator
SU	Situational Unit controller

THIS PAGE INTENTIONALLY LEFT BLANK

ACKNOWLEDGMENTS

THIS PAGE INTENTIONALLY LEFT BLANK

I.   INTRODUCTION

A.   PURPOSE

The U.S. Coast Guard manages many of its maritime domain responsibilities from Command and Control (C2) Command Centers (COMCEN) located in various geographical areas about the U.S.. A C2 organization manages its specific operational responsibilities by the acquisition of situational awareness that leads to proper decisions and rightful action. In any C2 duty watch environment, there are observable evidences of situational awareness degradation as one watch-stander transfers the current situational awareness to the next. During a twelve-hour operational watch, the experience and knowledge a watch-stander acquires may become difficult to share during the short watch relief period. Information technology (IT) systems assist to facilitate the capture of explicit knowledge, but are not usually successful for the capture of tacit knowledge. Tacit knowledge is difficult to express because of the challenge to articulate and takes considerable time compared to explicit knowledge (Nissen 2006). Since tacit knowledge is necessary to perform an action, the inability to transfer tacit knowledge sufficiently during a watch changeover can diminish the C2 performance and adversely affect one's ability to make decisions or respond effectively (Ambrosini and Bowman, 2001). There may be several explanations for a C2 organization to experience situational awareness degradation such as a result of organizational knowledge management shortfalls, or absence of implementing knowledge principles and best practices. The Coast Guard has not yet explored the unique circumstances that surround knowledge behavior in an operational watch environment or how knowledge affects people, learning and operations. The purpose of this study is to examine knowledge flows within a Coast Guard C2 environment and discover how knowledge contributes to situational awareness. The study also seeks to understand how organizational behavior affects knowledge flows. This study focuses on a C2 organization for the extraction of observable qualitative data. Data collection will provide the necessary information to conduct a knowledge audit for examination, analysis, and conclusion. For example, how a watch-stander creates,

formalizes, stores, retrieves, and transfers knowledge in a manner favorable not just to reduce instances of lost knowledge, but how it can improve Knowledge Management (KM) for C2 situational awareness or any another aspect important to the management of C2.

The Coast Guard has not yet explored the unique circumstances that surround knowledge behavior in an operational watch environment or how knowledge affects people, learning and operations. The purpose of this study is to examine knowledge flows within a Coast Guard C2 environment and to discover how knowledge contributes to situational awareness transfer from one Coast Guard C2 operational watch-stander to the next. This study also seeks to understand how organizational behavior affects knowledge flows. This study focuses on a specific C2 organization to extract observable qualitative data by conducting a knowledge audit for examination, analysis, and conclusion. For example, how a watch-stander creates, formalizes, stores, retrieves, and transfers knowledge in a manner favorable to reduce instances of lost knowledge or how it can improve KM for C2 situational awareness or another aspect important to the management of C2.

B.   BACKGROUND

The Al-Qaida terrorist attack against the American people on September 11, 2001, (9/11) serves as a reminder to its citizens of how vulnerable the U.S. was to national security threats and how difficult it was (and still is) to prevent them. If the Coast Guard is to manage these security concerns, an increase in the maritime domain awareness and maritime security are necessary to protect U.S. shores from criminal intent. In 2002, the President and Congress created the Department of Homeland Security (DHS) to meet the challenges of protecting the homeland in a period of prolific global terrorism. The creation of DHS combined several federal agencies, including the Coast Guard, to thwart or deter possible criminal action against the U.S.. It is the function of the C2 COMCEN to develop the necessary situational awareness to assess each national security threat and respond appropriately. The situational awareness at the C2 COMCEN level is in addition to the Coast Guard intelligence branch that gathers intelligence on all

Coast Guard missions to attain situational awareness at the organization level. The C2 COMCEN situational awareness is specific to the missions and operations specific to the D11 AOR.

Obtaining situational awareness in a C2 environment is essential for an organization to accomplish its mission or meet specific operational objectives. Making sense of a situation compromises several cognitive processes that begin when awareness allows a decision to act (Alberts & Nissen, 2009). On the other hand, several external factors may influence situational awareness, such as intelligence collection, organizational structure, job expertise, job experience, and the C2 maturity model to name a few. Situational awareness is the basis of which Coast Guard members make vital decisions that support organizational missions and execute tactics that will save lives and property, protect the environment, and provide security to the nation's homeland. Since knowledge serves to develop situational awareness, an organization needs to understand, practice, and rely on an appropriate knowledge program.

C. KNOWLEDGE IN A C2 ORGANIZATION

The C2 operational environment encompasses all facets of knowledge from its creation to the sharing of tacit knowledge. Knowledge is fundamental to what we know, why we know it and how we use what we know. When an organization understands how to use knowledge and its practices become part of the daily routine, organizations develop an ability to use prior knowledge to recognize the value of new information, assimilate it and apply it to create new knowledge and capabilities (Gold, Malhotra, & Segars, 2001). A C2 organizational environment requires a robust knowledge management program to achieve situational awareness for the purpose of making decisions and take action.

IT systems provide a means to capture knowledge, store, and have it always available for extraction at a moment's notice. Although there are engineering limitations to IT systems design, Claire and Brisset (2000) provide research results of design knowledge repositories for intelligent decisions support systems in a C2 environment that

support knowledge intensive organizations. Their approach is to design an application that generates intelligent documentation for search and rescue (SAR) operations that use an engineered ontology. The purpose is to increase the value of knowledge of the organization and in providing knowledge workers with the right information at the right time. Their domain of interest—similar to the requirements of the U.S. Coast Guard— focuses on SAR, where controllers conduct operations to search for and rescue missing aircraft and vessels (Claire & Brisset, 2000).

An example of how knowledge acquires situational awareness in a C2 organization is when during an investigation of a given SAR incident. The relevant collected C2 information must support a search plan and allocate resources for rescue. Numerous sources provide specific details about the incident. However, the knowledge required to plan and execute the mission is typically part of the background knowledge of the C2 operators. This background knowledge and know-how are based upon standard operating procedures, historical information and databases, service-wide documents and personal experiences. Sources can exploit this information when it is formularized and structured appropriately. Many consider experiences to be the most valuable knowledge assets integrated into the organization's memory (Claire & Brisset, 2000).

Most people use knowledge intuitively through socialization and formal learning as most knowledge resides in documents as explicit knowledge or the experts' memories as tacit knowledge (Claire & Brisset, 2000). In other words, we tend to use what we already know instead of realizing there is more to know. In some rare cases, when people use evidence-based self-knowledge, they will admit that they do not know what they do know, until they know it (Lieberman, Jarcho, and Satpute, 2005). Much about knowledge is cerebral in that it requires learning and cognitive processes to comprehend and manage. It is by formal processes that we learn how to apply knowledge and how will provide the military C2 organization a competitive advantage over its adversaries. Dalkir (2002) refers to learning as "an organization's capability to gain insight and understanding from experience through experimentation, observation, analysis, and a willingness to examine both successes and failures." In addition, the origin or source of information are not

always exploited efficiently for C2 Commanders to obtain all relevant information and make informed decisions. Research in KM has gained popularity amongst organizations that desire a competitive advantage. These companies promote the creation, sharing and leveraging of knowledge within an organization to maximize business results that also provide similar benefits to government C2 organizations (Claire & Brisset, 2000).

Although not all organizations have the same knowledge concerns or level of requirements, this study will provide a baseline of knowledge levels for knowledge improvements and future studies.

D. RESEARCH QUESTIONS

This study examines the following questions:

1. Primary Research Questions:

a. How does knowledge flow within the C2 organization?

b. How do knowledge flows affect the transfer of situational awareness knowledge from one watch-stander to another?

2. Secondary Research Questions:

a. What behaviors within the organization may contribute to the loss of knowledge?

b.   What are the influences that affect the organizational knowledge culture?

c. How can the Coast Guard improve C2 situational awareness of what it learns from the unit's knowledge flows?

E. SCOPE OF THESIS

This research focuses on conducting a knowledge audit on a Coast Guard C2 COMCEN and examines how their current knowledge processes affect their situational awareness. The COMCEN provides a dynamic operational environment of watch-stander

positions that will support the objectives of this study. Research methods from previous studies and literature will serve to examine the knowledge flows, relationships, and maturity in a watch environment.

F.   ORGANIZATION OF RESEARCH

Chapter II is a literature review of all pertinent studies and articles relating to what we currently know about knowledge. It provides an understanding of what knowledge is, what the knowledge processes are, how to use knowledge within an organization and how organizational behavior contributes to the usage of knowledge. The information acquired also serves to provide guidance to conduct a C2 knowledge audit for this study. Chapter III explains the methodology used to collect data and information for the analysis in Chapter IV. Chapter V completes the paper with the conclusion and recommendations for future studies.

G.   RESEARCH BENEFITS

The examination of knowledge in a C2 environment provides unique academic opportunity for learning how organizational behavior affects situational awareness. In addition, Observations of the watch environment can assist with understanding decisions that enable action. Each element of a C2 structure provides a component of the knowledge equation that ultimately determines the quality of knowledge within an organization. It is the watch environment where the generation and formation of organizational knowledge takes place. Management of an organization is interested in using knowledge acquired during a watch-stander activity because it leads to the knowledge enhancement and transfer of knowledge to subsequent watch-standers. Effective use of knowledge enables direct action in a watch environment such as correct decisions, appropriate behaviors and useful work (Nissen, 2006). The design of the study is to understand knowledge flows, identify inhibiting factors and encourage attributable knowledge behaviors to improve situational awareness for suitable decisions and actions.

II. LITERATURE REVIEW

A. INTRODUCTION

This chapter includes brief background history of the Coast Guard, its missions and enough detail of a Coast Guard C2 COMCEN organization for rudimentary understanding. The Coast Guard C2 watch environment is similar to other Department of Defense (DoD) and federal agencies. However, enough of a difference exists that necessitates explaining its organizational structure and mandated missions. To understand how the organization uses knowledge, Chapter IV discusses specific details regarding the COMCEN watch environment as it pertains to the analysis of the study.

This chapter also discusses the literature of knowledge from studies and articles to explain its numerous concepts known by the leading experts. The knowledge topics discussed will provide the background to support the analysis given in Chapter V. In addition to explaining knowledge concepts, the literature review serves as a basis to conduct a C2 knowledge audit. Understanding the fundamentals of knowledge, one can examine an organization's knowledge position by comparison.

B. BACKGROUND

1. United States Coast Guard Brief History

In 1790, The First Congress of the United States established the Revenue Cutter Service to collect custom duties and prevent the smuggling of trade goods across the U.S. borders. This small maritime law enforcement agency acted as the nation's maritime defense until the reestablishment of the Navy by Congress. As the nation grew and discovered new technologies, issues and concerns regarding maritime security and safety became more prevalent. As a result, Congress passed laws and regulations to expand the small service's responsibilities. Throughout the following years, Congress consolidated and merged complementary federal agencies with the Revenue Cutter Service. The result is today's United States Coast Guard, a unique civil and military armed force involved in every aspect of the United States maritime environment (U.S. Coast Guard, 2009).

Under the direction of DHS the U.S. Coast Guard is legislatively mandated to safeguard U.S. harbors, ports and waterfront facilities from accidents, negligence, terrorism, etc., as part of its "homeland security" mission. Moreover, as a law enforcement entity, the Coast Guard responds to other homeland security threats such as counter-narcotics operations, weapon smuggling and illegal immigration. Contrary to mainstream perception, the Coast Guard does not just remain on the U.S. coastline. It also safeguards overseas military ports and harbors to protect U.S. assets as part of its homeland defensive role. Its maritime homeland security, law enforcement, and homeland defense responsibilities cover 95,000 miles from the U.S. coastline and the seas out to 200 nautical miles for area of 3.4 million square miles, including 360 ports (McGrath, James III, 2002).

In response to the post–9/11 security threats and expansion of Coast Guard responsibilities, it became necessary to restructure the organization to compensate and operate more effectively. The Coast Guard merged regional units into a "Sector" concept (centralized commander) that combined the assets and mission of several Coast Guard units under one Sector Commander.

Each Sector Commander is subordinate to a larger District Commander, which reports to the East Coast or West Coast Area Commander depending on its geographical area. A Sector incorporates units such as a Coast Guard Group, Small Boat Stations, C2 COMCENs, Marine Safety Offices, Vessel Tracking Safety units, and Captain of the Ports. The new Sector functions as a single-unit. As a result, the reorganization centralized their multi-agency nature (Customs, Immigration, commercial, local, state, and federal law enforcement) to a centralized approach of meeting mandated requirements. Figure 1 displays each of the three levels of Coast Guard command. The Pacific Area and Atlantic Area commands are shown with a solid North-South line that divides East from West in the middle of the nation where each District commander is located within a specific Area Commander.
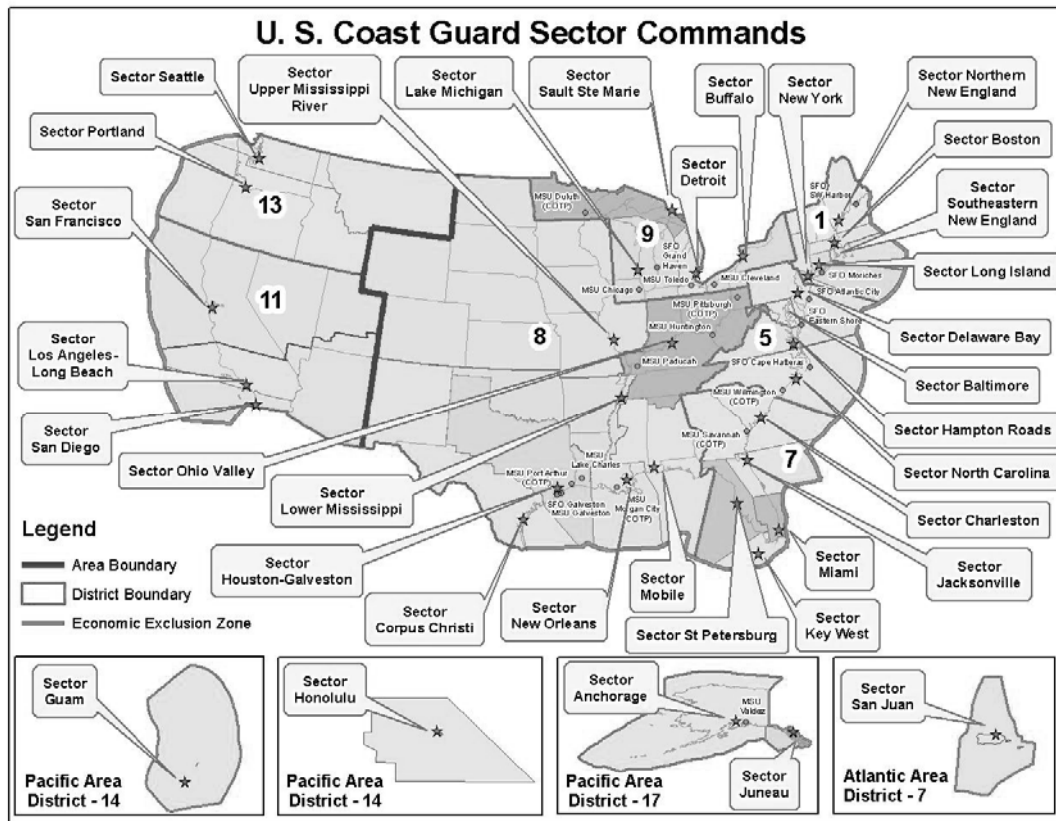
Figure 1.   U.S. Coast Guard sector commands (From U.S. Coast Guard, 2007)

2.   Coast Guard C2 COMCEN Organization

The C2 COMCEN facilitates the execution of all Coast Guard missions and provides valuable information and coordination capability to other governmental agency partners around the clock. It provides the operational commanders and the Coast Guard organization a professional and continuous C2 platform for coordination and enhanced operational effectiveness in achieving Coast Guard mission objections and for other federal, state, local, and private agencies operating in the maritime environment. C2 COMCENs possess technology and communication systems to interoperate with other agencies for direct liaison with Coast Guard personnel (Watts, 2005). The COMCEN is a

component resource used by the Coast Guard to achieve situational awareness and manage its mission portfolio across the broad maritime domain as shown in Figure 2 (U.S. Coast Guard, 2007).
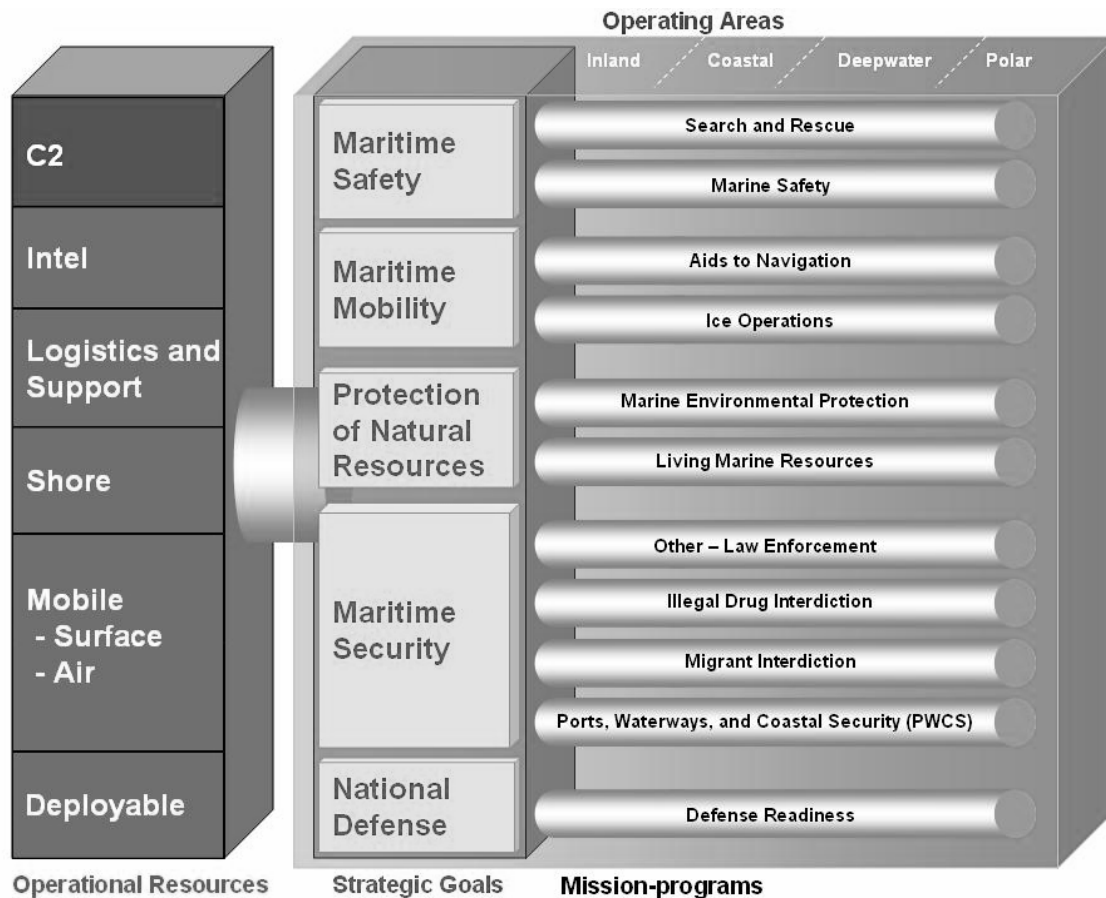
Figure 2.   Coast Guard mission areas (From U.S. Coast Guard, 2007)

3.   C2 COMCEN Relations

The C2 COMCEN functions as the primary point of contact within its AOR for tactical maritime operations and coordination with other C2 COMCENs. C2 COMCEN receives requests for Coast Guard (and other maritime resources) for translation to maritime domain awareness (MDA), then into appropriate action. The C2 COMCEN maintains a variety of relationships to accomplish MDA missions, see Figure 3 (U.S. Coast Guard, 2007).
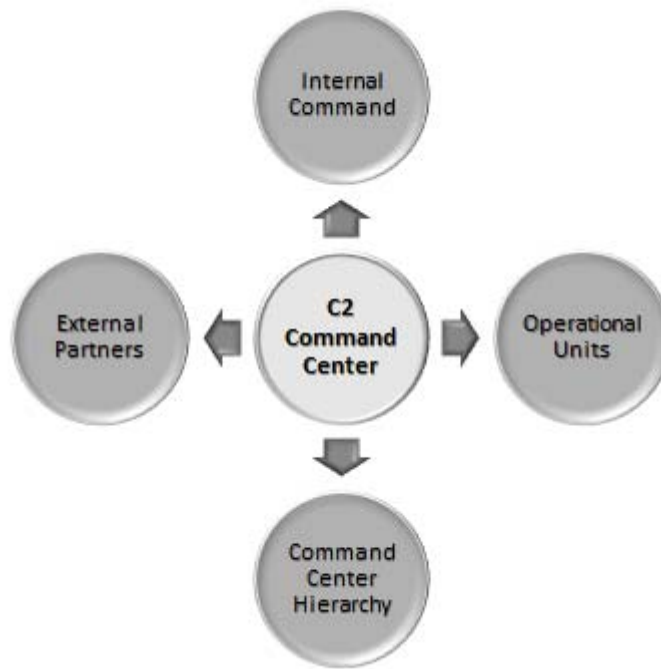
Figure 3.   C2 COMCEN relationships (After U.S. Coast Guard, 2007)

    a.   **Internal command** relationships include the operational commander and his or her staff. The C2 COMCEN is responsible for providing the operational commander with the current situational awareness.

    b.   **C2 COMCEN hierarchy** represents the direct relationship between subordinate C2 COMCENs acting on behalf of the operational commander. The relationship ensures proper communication and situational awareness in the management and oversight of tactical operations and other non-operational matters.

    c.   **External partner** relationships include partners from the DoD, federal agencies, private maritime industry, international governments, non-governmental organizations (NGO), state and local governments.

    d.   **Operational Units** are the deployable resources assigned to a specific AOR subordinate to the operational commander.

C.   COMMAND AND CONTROL

The mission challenges of the 21st century have increased significantly due to the dynamics of changing world events. Today's missions differ from traditional military missions as U.S. policy emphasizes a change from hard-power to soft-power, including how missions operate and manage resources. Today's missions are simultaneously more complex and more dynamic, which requires the collective effort of all government and civilian agency capabilities to succeed. The advent of new concepts of operations, fresh approaches to organizational C2 processes, and the implementation of cutting-edge IT systems have resulted from an increase of capabilities that provide a significant increase beyond the ability manage these challenges (Alberts & Hayes, 2006).

There is a consensus that most military leaders cannot agree on a definition of what C2 is and how to use it. However, many do agree on its common characteristics: A C2 environment has a hierarchy with a senior person or unit commander in command, which is responsible for its operations (Pigeau & McCann, 2002). Obtaining data, information, and knowledge from both internal and external relationships will generate situational awareness. From this position, the senior commander attempts to control a specific situation or problem using subordinate commands at his or her disposal. The formulation of knowledge from data, information, and knowledge collection processes in a C2 operational environment requires knowledge-intensive activities. Most knowledge resides in informal documents or in the minds of experts. This prevents proper formalization of available information. This result is the inappropriate exploitation by C2 commanders to obtain relevant information and make informed decisions (Claire & Brisset, 2000).

Network-centric operations is a successful method to attain situational awareness. Network-centric operations have a two-step process: First, achieving shared awareness and second, leveraging shared awareness to achieve a greater degree of self-synchronization for increases in agility and effectiveness. The magic is the emergence of self-synchronizing behavior. Like many of our coalition partners within the DoD, investment in network-centric warfare builds a robust, secure, ubiquitous infrastructure of

IT systems and command structures. As a result, the coming years will see an increase in the quality of service and interoperability. The DoD data strategy is to facilitate and encourage widespread information sharing and collaboration of these steps (Alberts and Hayes, 2006).

In addition to network-centric warfare, several factors influence situational awareness, such as information gathering, organizational structure, expertise, job experience, and knowledge maturity. It applies to the Coast Guard as a basis for which Coast Guard members make vital decisions to support organizational missions and execute tactics that save lives, protect property, protect the environment, and provide security to our homeland. Since knowledge serves to develop situational awareness, it is imperative that knowledge processes become clearly understood, practiced, and implemented.

D. DECISION MAKING

Obtaining situational awareness in a C2 environment enables decision making, which in turn enables an organization to take action and accomplish its mission or meet specific objectives (Nissen, 2006). The sense of our reality is comprised of several cognitive processes. It is when awareness reaches a certain level and ends at a point where a decision to act is achieved (Alberts & Nissen, 2009). Moreover, decision-making has proportional consequences based on the importance of the problem. Take, for example, a sailboat at sea taking on water. The current situational awareness may contain limited information such as sea state, approximate position of the vessel, number of people on board, weather status, tides and currents, and how long people can survive in the water. How a decision is made is based on this information with other external information, such as, the type of response (aircraft or vessel), arrival time on the scene and type of medical assistance required. Once the course of action is decided, all further decisions will result from new information or change of circumstances. A C2 organization needs a firm grasp how knowledge is created, obained, and formalized. Otherwise, it would lack the coherent vision to manage and integrate knowledge processes, information processes and information technologies (Choo, 1996).

Zeleny (2006) provides the process of how decisions are made. Decision-making is a process of several important questions answered. What is to be decided and who makes the decision? What is the process of making decisions? In addition, why there is a specific decision for acceptance and implementation? Prior to making a decision, an organization collects unbiased and objective information problem, its contexts, and scope. After the collection of data, the search begins for relevant information known as the information stage. During the knowledge stage starts an engagement process of cognitive analysis. Evaluation of alternatives and comparisons determine decision criteria and prioritize data as relevant or not. The coordination of activities leads toward a purpose of determining a course of action, decision, or problem solution. In this stage, an attempt is made to determine which decision-making activities will achieve the purpose. In the post decision stage, an attempt to justify the decision by answering the why question, of its preference and implementation. Then, after an organization gathers additional information for preparation, the wisdom stage is the next step in the decision-making cycle. Affirmation knowledge and wisdom stages are natural processes in quality decision-making. An organization wants to know what, how and why decision-making activities happen and why its implementation as summarized in Table 1.

.

Information Stage	Define the 'what' by accumulating unbiased, objective information about the problem.
Knowledge Stage	Determine the 'how' by identifying a course of action based on coordinated analysis activities
Wisdom Stage	Justify decision by answer 'why' the course of action chosen and gather additional information for further decisions.

Table 1.   Summarization of decision-making stages

Zeleny (2006) explains that knowledge refers to the process of inputs through coordination of action. These rules of coordination (sequences, patterns, levels of

performance), are derived from the knowledge characteristics (not information) of experience, observation, consequences or social prescription. It is the rules that determine the formation of knowledge (Zeleny, 2006). Organizational decision-making is complex, messy and no doubt a vital part of organizational life: "All organizational actions are initiated by decisions, and all decisions are commitments to action" (Choo, 1996).

E. WHAT IS KNOWLEDGE?

A precise definition of knowledge has eluded a standard agreement of scholars and philosophers. On the other hand, they commonly agree that knowledge is a matter of one's own perception. There is little argument that knowledge is a complex autonomous discerning process of reasoning skills and experience. This distinguishes the cognitive process from opinions, speculations, beliefs, or other categories of unproven information (Liebeskind, 1996). Plato defined knowledge as 'justified true belief' a concept debated over the centuries by numerous philosophers. Erudition of these debates suggests that knowledge originates as information before its productive use as knowledge (Rowley, 2007). Depending on context, knowledge as a resource is always located within the individual, group, or process (De Long and Fahey, 2000). "Knowledge should refer to the observer's distinction through which one brings forth the background of experience as a coherent and self-consistent set of coordinating actions" (Zeleny, 1987). Knowledge cannot be separated from the process of knowing (establishing relationships) since knowledge and knowing is a knowledge process (Zeleny, 2006). Understanding what knowledge is and how to use it in a C2 environment is an absolute certainty for decision-making.

According to De Long and Fahey (2000), there are at least three specific types of knowledge:

Human Knowledge: What individuals know or know how to do. People possess individual knowledge known as skills or expertise, which is a combination of explicit and tacit knowledge. This type of knowledge is located throughout the body such as knowing how to ride a bike, or is cognitive that is conceptual and abstract.

15

Social Knowledge: This form of knowledge exists with the sharing of knowledge of individuals or groups through relationships. Social or collective knowledge is typically tacit, shared by group members and develops only through collaboration.

Structured Knowledge: Structured knowledge is integrated throughout the organization by processes, tools and routines. In this form, knowledge is explicit and has a basis on rules. It is different from human knowledge and social knowledge as it is considered an organizational resource that exits independently of human knowers.

F.   KNOWLEDGE FOR A COMPETITIVE ADVANTAGE

Competitive advantage is at the heart of an organization's performance in competitive markets relying on the implementation of broad generic strategies (Porter, 1980). Generally, competitive advantage refers to the private sector perspective of how it obtains a higher value over similar product or service producing organizations. However, a competitive strategy for the U.S. military requires no less an active approach against its challengers. It is imperative for the U.S. military to maintain an advantage in all sectors and factors of national defense. This includes a C2 environment where assessments of necessary consequences are routinely decided. The management of knowledge has become critical for instituting competitive advantage and has evolved into an organizational strategy by management (Gupta & McDaniel, 2002).

A recent trend in the field of strategic management is the emphasis of organizational knowledge as a basis of competitive advantage between organizations. Empirical findings support the case for organizational resources as the center of competitive advantage. The development of competitive advantage resources as a priority is a valuable asset for any organization (Argote, 2000). Therefore, in order for a competitive advantage resource to materialize, it must be difficult for competitors to imitate (Lippman and Rumelt, 1992). Nissen (2006) states that knowledge resources are usually arduous to imitate and are socially complex thus capable of long-term sustainable competitive advantage: "Knowledge represents one of the few bases of sustainable

competitive advantages available to the modern enterprise, but knowledge is distributed unevenly through most organizations" (Nissen, 2006).

G.   KNOWLEDGE MANAGEMENT

Knowledge Management (KM) systems take on a new importance in economics where it is seen as a competitive factor for individuals, corporations, and nations. The reality of this driving force is what supports the development of broad adoption and continuation of powerful methods and tools to manage knowledge (Wiig, 1997). Knowledge Management originates from the idea that its very purpose and value has a basis on knowing that valuable knowledge exists. All one needs to do is capture, codify and share it. That is, to enhance the deployment of knowledge into practice through taking appropriate steps to permeate the minds of the organizational members who need it (McElroy, 2002). Leaders of progressive organizations seek active ways to create and drive value from knowledge assets. These efforts are championed by people with strong personal beliefs and convictions that desire success. In the absence of a specific KM strategy to create and integrate knowledge in the organization, tools such as information systems facilitate the transfer of knowledge and information sharing, but have minimal effect at best. The result inspires organizations to implement the design of information systems specifically to perform the codification, collection, integration and dissemination of organizational knowledge (Alavi & Leidner, 1999).

KM provides a system in which an organization's employees use knowledge processes in addition to the knowledge at their disposal. The purpose is to perform an assortment of knowledge activities. The activities typically include, at a minimum, acquiring knowledge from external sources of the organization, selecting knowledge from within the organization, and creating new knowledge as an integrated process. The product introduces a new internalization of knowledge that benefits the organization (Holsapple and Joshi, 2000). A well-defined knowledge management system has the potential to improve decision-making, best practices, organizational learning and competitive advantage.

H. KNOWLEDGE HIERARCHY

The development of several hierarchical descriptions of knowledge appeared over time which apply to either the individual or organization. In an organizational environment, a richer taxonomy is required to contain some of the complexity involvement in storing and sharing knowledge (Johnson, Lorenz, & Lundvall, 2002). This section contains three different, but similar knowledge hierarchy models for comparison by leading knowledge academics. The models provide an understanding of their unique perspectives of different levels of knowledge development. It begins with the most fundamental elements, then building upon each step, creates a higher complex level of maturity.

1. Zeleny Knowledge Hierarchy Model

Zeleny (2006) describes knowing as an evolution of progression towards wisdom. Although the idea or perspective of wisdom is full of substantial and significant philosophical meanings, wisdom needs to be to be pragmatic, practical, and useful. As a resource, wisdom management fosters organizational efficiency, effectiveness and positive ethical conduct. Zeleny (2006) describes his knowledge hierarchy analogous to baking bread.

Data (Know-nothing): Elements or parts that by themselves that have little meaning such as H2O, yeast bacteria, and starch molecules. It has the effect of muddling through since it lacks context and meaning.

Information (Know-what): The interpretation of a sequence of elements or in this example, ingredients such as flour, water, sugar, spices, and a recipe. It has the effect of efficiency.

Knowledge (Know-how): Coordination processes that produce results such as baking the ingredients into a loaf of bread. It supports effectiveness.

Wisdom (Know-why): Why one does it, such as making white bread and knowing why to produce it, and why to produce it this way. It has the effect of explicability.

Many people are informed and know what to do; quite a few people are knowledgeable and know how to do it. Only a few wise people can fully explicate the meaning of why it done (Zeleny, 2006). Figure 4 demonstrates the progress of Zeleny's knowledge hierarchy model. As the maturity of knowledge compounds upon the previous level, the knowledge has more purpose and more effect towards usefulness.
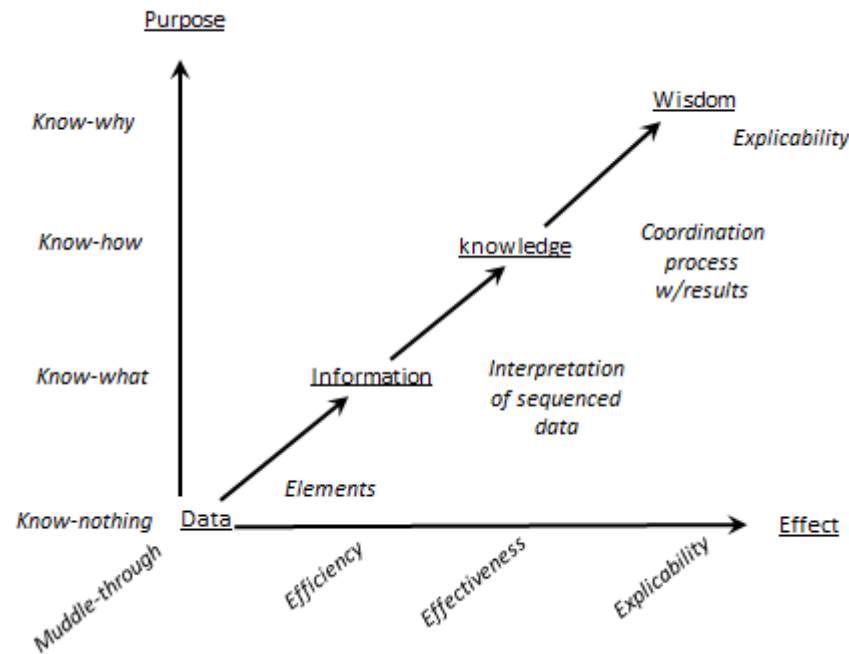
Figure 4.   Zeleny Knowledge Hierarchy Model (After Zeleny, 2006)

2.   Nissen Knowledge Hierarchy Model

Nissen (2006) explains the uniqueness of data, information, and knowledge by describing their differences as it applies to the hierarchy model. There are three levels of knowledge hierarchy, each one builds upon the level below it. Data can reduce uncertainty and ambiguity of a problem and results with the production of information. However, information is more than just the sum of its parts. It must have context to attain meaning of the message. Information assists people to make sense of their environment and is necessary for knowledge production. Even so, just as information requires more

than data, knowledge involves more than just information. It requires semantics and pragmatics of knowledge in context for decision-making enablement and direct action (Nissen, 2006).

Nissen (2006) uses the analogy of sending an e-mail message to explain his view of the knowledge hierarchy.

Data (Symbols): An e-mail message with the understandable characters "333/33," but, without some kind of comparable context, the characters have no meaning or reference.

Information (Context): The e-mail now contains the statement 'blood pressure 333/33.' Now there is context for the message and gives it meaning. One now knows what the data represents but without intimate knowledge, the information does not allow action.

Knowledge (Supports action): You hear from your physician that explains what the information represents. If the first number is above 200 and if the second number is below 60, there are serious health concerns. The knowledge can now enable action as a response to the health problem.

Nissen demonstrates his knowledge hierarchy model in Figure 5, using two dimensions of abundance and action ability to differentiate between three descriptions of data, information, and knowledge. Data resides at the bottom level with information about the middle and knowledge at the top. On a grand scale, the amount data available is much more prevalent than in comparison with the amount knowledge it generates. The model displays a decreasing abundance as actionability increases from data to knowledge.
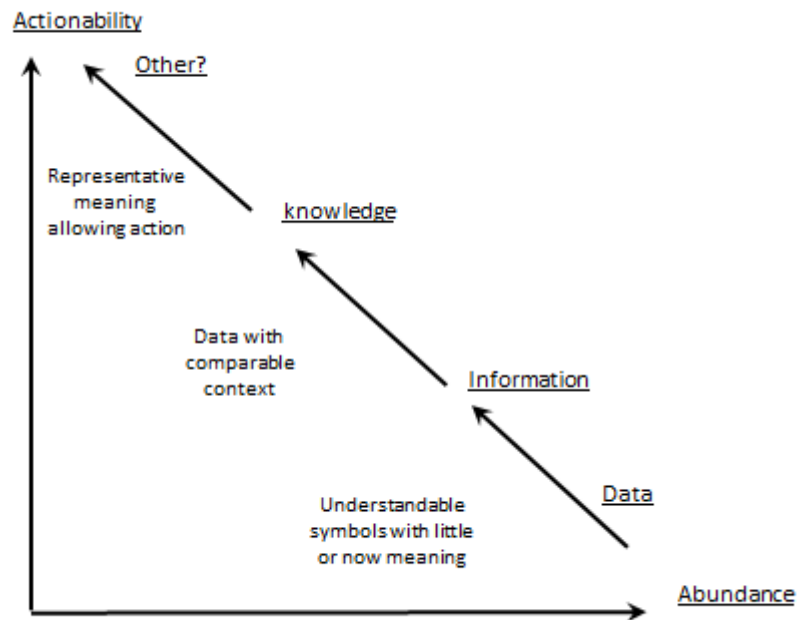
Figure 5.   Nissen Knowledge Hierarchy Model (After Nissen, 2002)

3.   Ackoff Knowledge Hierarchy Model

Russel Ackoff (Bellinger et al., 2004) promotes the knowledge hierarchy as the human mind divided into five categories. The first four categories relate to the past of what has been or already known. The fifth category, wisdom, relates to the future. To achieve wisdom, one must successfully accomplish each preceding category. Bellinger et al. (2004) provides the following elaboration of Ackoff's definition of the five knowledge categories.

Data (Symbols, no understanding): No significant meaning beyond its existence due to lack of context. It may exist under any form, whether usable or not.

Information (Who, What, Where and When): Data with meaning through a relationship of connections. The meaning is useful, but necessarily so.

21

Knowledge (How, understanding of relations): A collection of information intended to be useful through a deterministic process. Having knowledge does not infer additional knowledge growth from itself.

Wisdom (Evaluated understanding, understanding principles): Wisdom is an extrapolative and non-probabilistic process, an iterative activity from all previous levels of knowledge. It generates discernment and judgment.

Understanding (Why): Is a cognitive and analytical process where knowledge amalgamates into new knowledge. The difference between understanding and knowledge is the same as the difference between learning and memorizing. People with understanding can undertake useful action because of their ability to synthesize new knowledge or new information.

Figure 6 demonstrates the relationships and sequences of Ackoff's hierarchy model. Connections describe the relationships and direction from data to wisdom as understanding applies to each knowledge level.
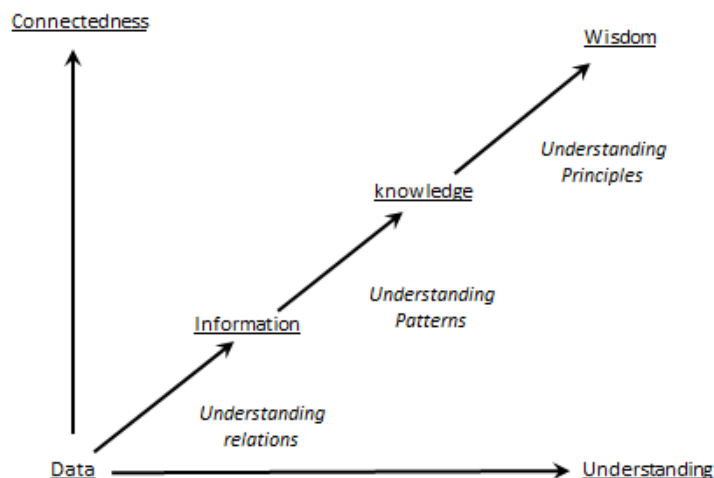
Figure 6.   Ackoff's Knowledge Hierarchy Model (After Bellinger et al. 2004)

Comparing the Zeleny, Nissen, and Ackoff models, we have a clearer representation and understanding of the knowledge hierarchies. How knowledge progresses through the stages from bits of meaningless data to supporting action as shown in Table 2. This framework provides us with the basis to understand the activities necessary to understand knowledge flows and the life cycle of knowledge.

Knowledge Progression	Zeleny	Nissen	Ackoff
Data	Know-nothing	Symbols – no meaning	Symbols - no meaning
Information	Know-what	Context	Who, What, Where and When
Knowledge	Know-how	Supports action	How – understanding relations
Understanding			Why
Wisdom	Know-why		

Table 2.   Summarization of Zeleny, Nissen and Ackoff (2006) knowledge hierarchy stages

I.   TACIT VERSUS EXPLICIT KNOWLEDGE

Smith (2001) and Hansen et al. (1999) explain that personal experience conveys tacit (know-how) knowledge, whereas explicit knowledge (know-what) is obtained through codification, and writing as known throughout recorded history. Historically, capital, materials, and labor were more valuable than creating and applying knowledge. However, the information age and the knowledge revolution generated a need for imaginative, intuitive, and inspirational leaders who can manage human intelligence for conversion into useful products and services (Smith, 2001).

The differences between explicit knowledge and tacit knowledge is commonly explained as what can be codified versus what is known, but cannot be articulated.

Explicit knowledge is expressed in words and numbers and shared in the form of data, scientific formulae, manuals, documents, etc. This kind of knowledge is easily transmitted between individuals formally and systematically (Nonaka & Konno, 1998). Whereas tacit knowledge is embedded knowledge that resides in people and is produced by people. Tacit knowledge is also personal knowledge commonly acquired through situational experience, deeply rooted in action and in specific context (Ambrosini and Bowman, 2001). Tacit knowledge has come to be referred as broad know-how knowledge that is hidden or implicit within an organization. Formalized (explicit) knowledge located in documents, processes and databases only represents a small fraction of what an organization knows (Horvath 2000). For an organization to benefit from tacit knowledge, it needs to know how to harness know-how knowledge and share it within the organization for observable benefits.

Horvath (2000), explains several reasons why tacit knowledge over explicit knowledge benefits organizations: 1. Innovation; sparking new ideas from personal experiences. If ideas become codified and structured into processes, they tend to inhibit creativity. 2. Best Practices; the explicitness of actual problems and real situations when combined with tacit knowledge tends to reflect how work actually gets done. In many instances, what is optimal for practice is not found in documentation but rather resides within the person. Tacit knowledge has a unique value added by the people that generate it. It emerges from their particular situations, skills and experiences that when combined, it provides a powerful capability for that organization (Horvath, 2000).

Nonaka and Konno (1998) explain that tacit and explicit knowledge can create new knowledge through a spiraling process of interactions. Moreover, that a combination of tacitness and explicitness make it possible to conceptualize four conversion patterns. Taken from Nonaka's and Knono's (1998) SECI model (Socialization, Externalization, Combination, and Internalization) in Figure 7, shows the characteristics of the four steps in the conversion process. The SECI model is abstract and serves only as an outline of knowledge creation but useful if put into practice.

24
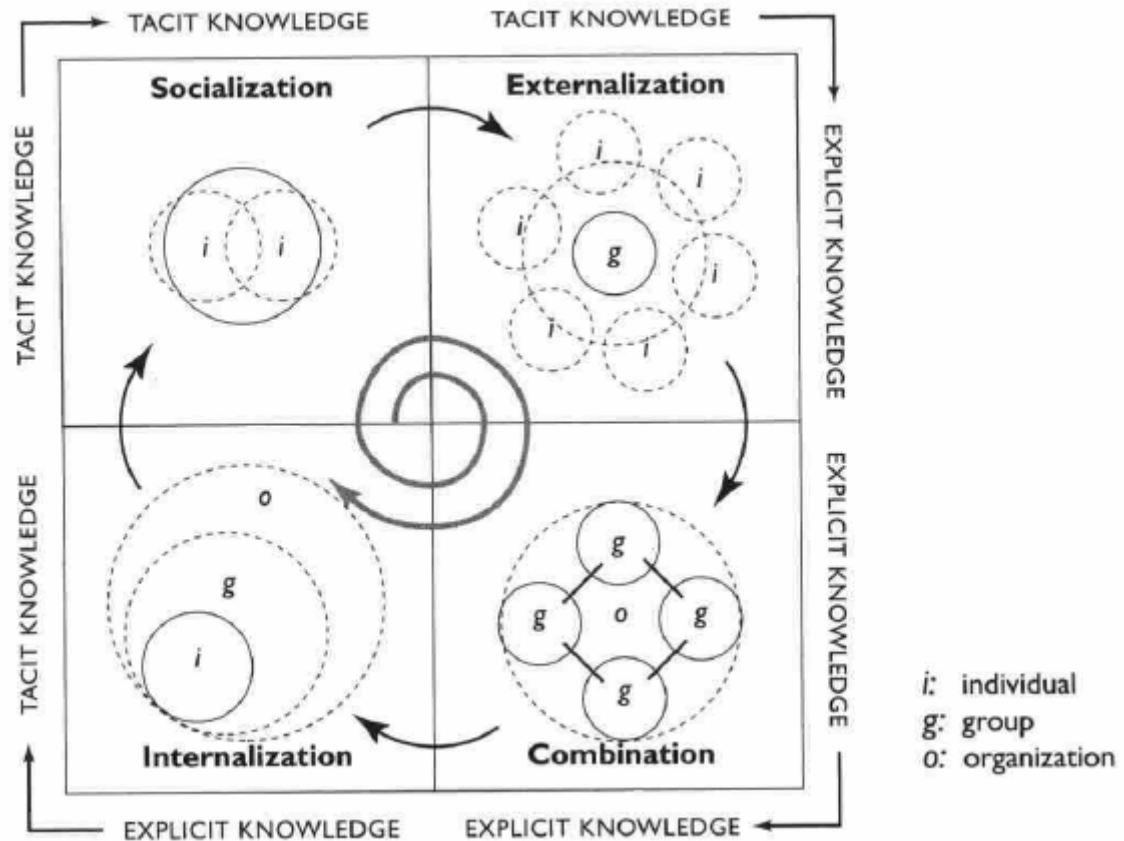
Figure 7.   SECI model (From Nonaka and Konno 1998)

Socialization: Socialization involves sharing of tacit knowledge between individuals (Nonaka & Konno 1998) or groups (Nissen, 2002) as an exchanged of joint activities such as living or working in the same environment rather than through written or verbal instructions. Apprenticeships are relationships that typically consist of years of sharing and understanding the ways of thinking and feeling. One must allow for an environment of trust and openness for tacit knowledge sharing. Socialization involves capturing knowledge through physical proximity largely supported through direct interaction. Knowledge distribution is another key aspect of socialization such as transferring one's ideas or images directly to other people (Nonaka and Konno, 1998). The model illustrates two individuals sharing knowledge through socialization within a joint activity (Nonaka & Konno 1998).

Externalization: Externalization requires the expression of tacit knowledge, and its translation into forms understood by others. During this stage of the knowledge-creation process, an individual commits to the group and then becomes one with the group. The sum of the individual's intentions integrates with the group thus exchanging tacit knowledge into explicit knowledge. Externalization is support by two key factors: First, articulation of tacit knowledge (conversion of tacit to explicit) such as metaphors, analogies or narratives. The second factor involves translating the tacit knowledge of experts through deductive/inductive reasoning or creative inference into explicit forms easy to understand (Nonaka and Konno, 1998). The model illustrates individuals fused into an interactive group that transfer tacit knowledge to explicit knowledge.

Combination: Combination involves the conversion of explicit knowledge into a more complex set of explicit knowledge of key issues for communication and diffusion in a systematization process. From the fresh knowledge generated during the externalization phase, it transcends to the group. The combination phase consists of three processes: First, the capture and integration of new explicit knowledge is essential such as collecting externalized knowledge (public data) either inside or outside the organization, then combining the data. Second, is the dissemination of explicit knowledge by transferring it directly through presentations or meetings. Third, involves editing or processing explicit knowledge, which makes it more usable (e.g., documents, plans, reports, and market data.). The combination process provides the justification and basis for agreement that facilitates organizational members to take practical steps (Nonaka & Konno, 1998).

Internalization: Internalization of newly created knowledge is the conversion of explicit knowledge into the organizations' tacit knowledge. Each individual identifies the knowledge relevant for him or her within the organizational, typically a result of learning-by-doing. Individuals who train and exercise can access the knowledge realm of the group and throughout the entire organization. Internalization relies on two dimensions. First, explicit knowledge translates concepts or methods about strategy, tactics, innovation, or improvement. An example is how training programs in organizations help trainees to understand the organization and themselves as part of the

whole (Nonaka & Konno, 1998). The model illustrates the conversion of explicit knowledge to tacit knowledge within the organization.

Nonaka's and Konno's SECI model describes the dynamic processes in which explicit and tacit knowledge are exchanged and transformed when knowledge is socialized, externalized, combined, and internalized within an organization. A benefit of the model in a C2 environment is a better understanding of how new knowledge is created, converted and distributed with individuals and groups within an organization. This knowledge can provide guidance for when and where learning and training should take place, the generation, and capture of knowledge, or perhaps the right time and place for implemented information.

J. KNOWLEDGE LIFE CYCLE

The knowledge life cycle model links all aspects of knowledge together in a knowledge management system of processes (Nissen, Kamel, & Sengupta, 2000). It is about getting the right information to the right people at the time with capturing and codifying tacit and explicit knowledge before it leaves the organization (McElroy, 2002). The knowledge life cycle provides a sequence of iterative steps to assist the knowledge manager with numerous knowledge designs such as information systems or designing an organization for knowledge competitive advantage. Drawing from Nissen, Kamel, and Sengupta, (2000) we begin to view how knowledge flows through an organization.

Knowledge life cycles are generally iterative processes of repetitive life cycle phases. Nissen, Kamel, and Sengupta, (2000) compares several proposed life cycles through research scholars by sharing similarities and creating a unified model as shown in Table 3. The Amalgamated table integrates the fundamental concepts and terms from all four life cycle models.

Model	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Nissen	Capture	Organize	Formalize	Distribute	Apply	
Depress and Chauvel	Create	Map/Bundle	Store	Share/Transfer	Reuse	Evolve
Gartner Group	Create	Organize	Capture	Access	Use	
Davenport and Prusak	Generate		Codify	Transfer		
Amalgamated	Create	Organize	Formalize	Distribute	Apply	Evolve

Table 3. Comparison life-cycle phases for Nissen, Depress and Chauvel, Gartner Group, Davenport and Prusak (After Nissen, Kamel, & Sengupta, 2000)

Knowledge Creation: Beginning with phase one, knowledge creation involves discovery in the development of new knowledge. Knowledge capturing requires only that the knowledge be original to a particular individual or organization (Nissen, Kamel, & Sengupta, 2000). A C2 environment captures knowledge in much of the same manner as creating or generating. Whether it is the discovery of the adversary's location, troop movement or an intention, C2 obtains knowledge through, intelligence collection and critical indicator analysis. Within an organization, knowledge creation teams or projects represent a key role in value creation (Nonaka & Konno, 1998). The Amalgamated model, therefore, seems more complete with its beginning of the creation step.

Knowledge Organization: In phase two, knowledge organization and formulation arises from the facilitation of knowledge sharing. Numerous technologies assist classification and clustering of knowledge through a broad range of technology and practices, including knowledge maps and semantic networks of knowledge concepts (Nissen, Kamel, & Sengupta, 2000). Knowledge is intangible, has no boundaries, and is dynamic. If not usable at a particular time in a specific place, it has no present value. Therefore, the use of knowledge requires a concentration of knowledge resources at a certain space and time. In other words, sharing of knowledge organizationally means that the staff can apply and develop necessary useful knowledge when it is needed. (Nonaka

and Konno, 1998). COMCENs use various information technology systems (e.g., database applications) to collect, categorize and share knowledge within the C2 organization and with external friendly agencies with similar interests.

Knowledge formalization: Phase three uses different terms (store, capture, codify and formalize) across each of the models, but they all address some sort of mechanism for making knowledge formal or explicit (Nissen, 2002). An organization exerts a continuous effort to formalize operating skills and experiences into objective knowledge through codification. The goal is to reduce and eliminate uncertainty in the operating tasks or seal off the operating core from its disruptive environment. Management is responsible for formulating written rules, procedures, and performance standards where knowledge is stored for organizational usage. An organization relies on information systems for knowledge aggregation and structure. However, a large part of tacit knowledge is lost in the formalization because of its difficulty to articulate (Lam, 2000).

Knowledge distribution: Phase four describes the necessity to transfer knowledge among individuals within an organization. Transfer within organizations is the process through which one group, department or division for example is affected by the experience of another (Argote, 2000). Knowing who should know what or to what level of detail is critical for making knowledge available and usable across the organization (Porbst, 1998). Important tasks of management can facilitate the process of interactions between organizational members. It makes them sensitive towards the environmental stimulus so that knowledge amplification and internalization contribute to the organization (Bhatt, 2000).

Knowledge Application: Three of the four models include a fifth phase for application, use or reuse of knowledge for solving problems or making decisions (Nissen, 2002). Organizational learning occurs when the organizational components obtain knowledge and recognize its potential usefulness (Huber, 1991). Peter Drucker (1993) explains that knowledge is the only meaningful economic resource of the post-capitalist or knowledge society. The correct role of management is to ensure the application and

29

performance of knowledge-to-knowledge exchange (Choo, 1996). Bhatt (2000) explains the possibilities of knowledge adoption from external sources. However, knowledge imitation is not easy such as in the past where Japanese companies imitated knowledge from western competitors for their own advantage.

Knowledge Evolution: In phase six, Depres and Chauvel include a sixth element called evolution, which defines the refinement and continuous development of all knowledge at that point. Knowledge evolution when taken to the next phase returns to creation phase one of the iteration process thereby completing the life cycle (Nissen, Kamel, & Sengupta, 2000).

The model is more readily discernible when presented as a cyclical life cycle model, Figure 8, (Nissen, Kamel, & Sengupta, 2000) versus the linear sequence noted above. Two distinct classes separate the model: Class I, sharing includes knowledge organization, formalization and distribution, which are activities supported from extant information technologies for a localized view of knowledge management. Class II, non-sharing activities do not correspond well with support from extant information technologies, which are performative in nature. This class applies evolution, creation and application in the enterprise performance aspect of knowledge management activities with people in the organization (Nissen, Kamel, & Sengupta, 2000).
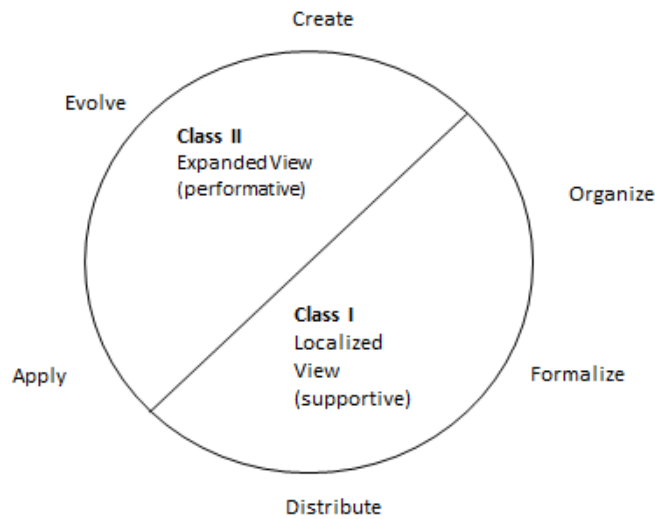
Figure 8.   Cyclical life-cycle model (From Nissen, Kamel, and Sengupta, 2000).

A knowledge life cycle within an organization is the process identified by creation, organization, formalization, distribution, and application. Eventually, the knowledge evolves to the point of creating of new knowledge. The organization chooses different strategies for each phase to foster knowledge optimization and accomplish shared goals. The challenge is for organizations to create an environment that demands and facilitates the generation and process of information.

The importance of knowledge spiraling is often due to its processes, which bring forth new perspectives on individual knowledge. Knowledge actuation within the organizational knowledge base transpires by checking its validity through debates and critiques at the group level (Weick, 1979). As an individual becomes a part of an organization, sharing of knowledge occurs for enhancing both the individual and organization. The integration between both individual and organization not only increases the organization's base knowledge, but also the organizations' learning capability (Bhatt, 2000).

K.   KNOWLEDGE FLOWS

The modern C2 environment is confronted with numerous obstacles to overcome as it struggles to obtain situational awareness in real-time to meet operational objectives. Information technology systems have the capacity to hold terabytes of data and the capability of delivery large amounts of information over computer networks almost instantaneously. Information flows such as intelligence reports, surveillance data, imagery and communications, surpass the ability of any commend center to analyze properly in an era where events change rapidly and quickly. Many incorrectly regard information management with knowledge management. Although IT systems provide valuable explicit knowledge, tacit knowledge is required for true situational awareness. Any lag in response to a situation is detrimental to a successful and timely response. If the life cycle of knowledge is to be of any use for C2 competitive advantage, it must enable effective action, which drives superior performance (Nissen, 2006). Therefore, knowledge flows are vital for communicating data, information and knowledge between individuals or groups for sharing, learning, generating, storing, retrieving and allocation.

The primary objective of knowledge flows is to transfer what is known from where it resides to where it is needed across space, time and organization. In other words knowledge is most effective when it is the disired knowledge, in the right place, at the right time. However, knowledge is not evenly distributed throughout the enterprise. This causes organizations to clump their knowledge thus restricting its flow. When an organization relies on the distribution of knowledge to know how to do what they need to do, knowledge clumping (without appropriate processes to allow knowledge to flow freely) can have a crippling effect on its operations (Nissen, 2001). Tacit knowledge flows are sticky, clumpy and slow, but often considered the most valuable resource within an organization when experiences combine existing knowledge (Nissen, 2006). Examining knowledge clumping in a C2 environment provides insight into inhibition of knowledge and how it affects knowledge flows.

Nissen (2006) describes the concept of knowledge flows as movements of knowledge across people, organizations, places and times between two knowledge

hierarchies shown in Figure 9. On the left, knowledge begins with the producer's source of knowledge as it travels through each layer of the knowledge life cycle until it is received by the consumer and formulated into tacit knowledge. Beginning with tacit knowledge, the producer articulates and codifies what he or she knows from learning into explicit knowledge, which enables action. The producer then uses this knowledge to create information for the production of data, which are in turn transmitted via signals across a physical space. The consumer interprets the data, develops viable information from semantics and context and next formulates actionable knowledge by learning (Nissen, 2007).
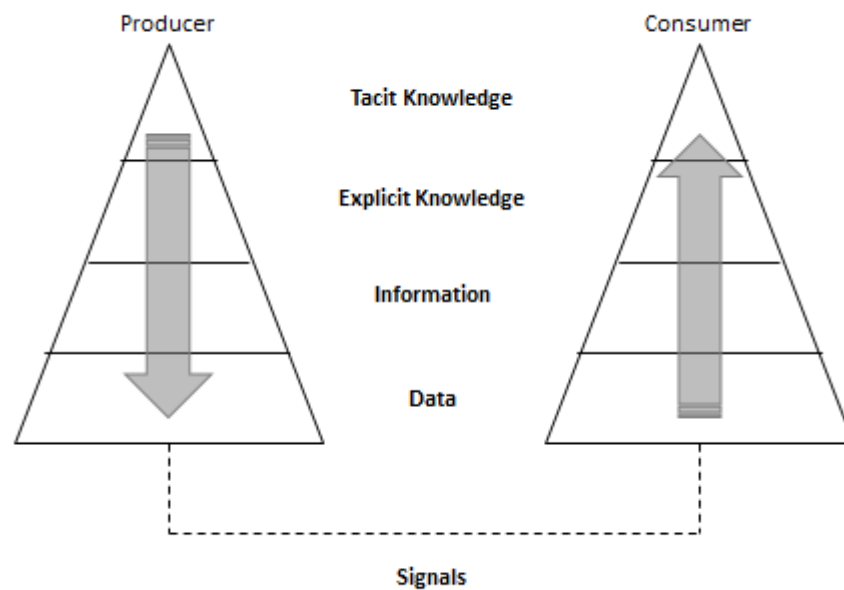

Figure 9.   Knowledge flows (After Nissen, 2007)

Knowledge transfer is more successful within organizations than between organizations. The argument is that knowledge sharing is more effective in an environment of relationships and trust (Ibrahim, Shumate, Levitt, & Contractor, 2006). A manager's endeavor to improve and foster an environment that facilitates knowledge

flows within an organization improves competitive advantage. Grant (1996) proposes four mechanisms to coordinate the integration of knowledge within an organization:

1. Rules and directives enable the conversion of tacit knowledge to explicit knowledge.

2. Sequence the workflow process to minimize communication but ensures the input of an expert on a different time slot.

3. Create routines to support complex patterns of interactions between individuals where no guidance exists or there is a lack of communication.

4. Establish a group problem solving and decision-making.

An organization's work in a global environment transcends nations, races, religions, businesses, and cultures. Differences can impede the ability to sustain knowledge flows and thus degrade competitive performance. Managing knowledge flows, diagnosing and dissolving intercultural knowledge clumps and clots that impede knowledge circulation, is critical to one's competitive advantage (Nissen, 2007).

Several dimensional attributes prominently affect knowledge flows over space and time. Take, for example, Nissen's (2006) four-dimensional knowledge flow diagram in Figure 10 that demonstrates knowledge flows within an organization. The explicit axis characterizes the degree of knowledge articulation in explicit form. The reach axis characterizes the level of knowledge socialization. The life cycle axis characterizes the knowledge stage of activity. The fourth dimension is flow time, which pertains to the length of time required for knowledge to move through the coordinates when considering the application of attributes of each of the three axes. The lines represent the length of time it takes for knowledge to flow. Thick lines represent slow movement and thin lines for quicker movement.
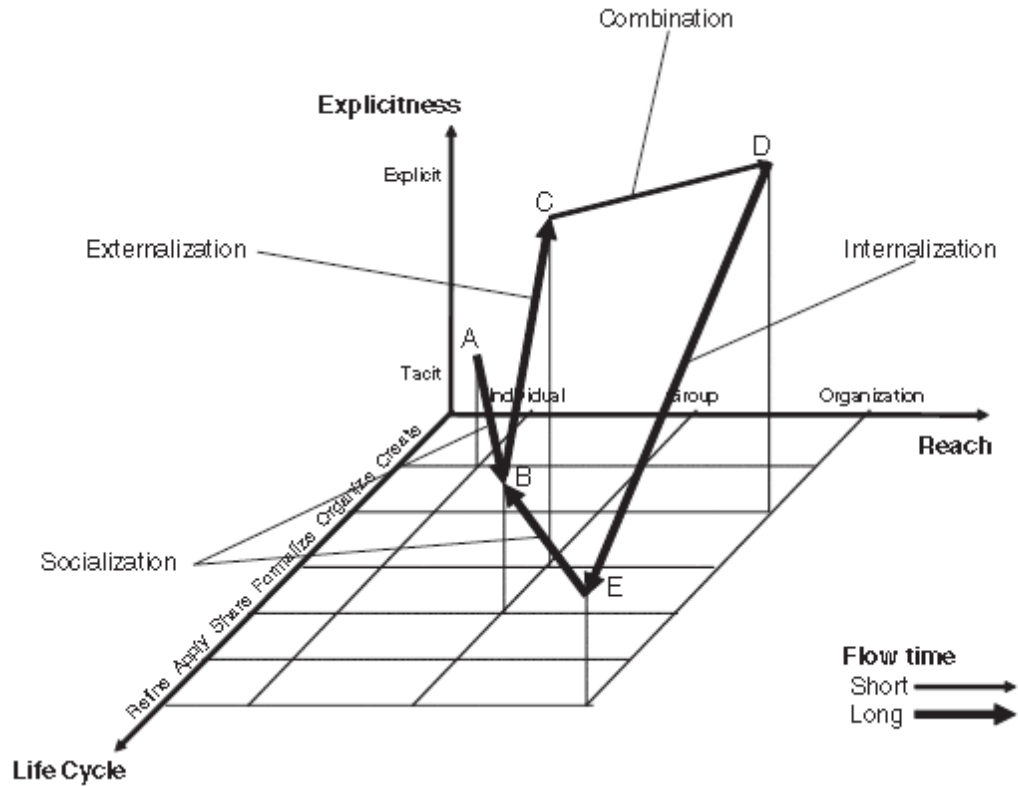
Figure 10.   Multidimensional knowledge-flow visualization (From Nissen, 2006)

Point A is the representation of tacit knowledge created by an individual. The socialization flow (A–B) reflects a movement of tacit knowledge across the reach dimension to the group level. The externalization flow (B–C) reflects a movement from tacit to explicit knowledge at this group level. The combination flow (C–D) reflects in turn a movement of explicit knowledge across the reach dimension to the organization level. In terms of flow time, notice the use of a thinner arrow to represent a combination flow as only explicit knowledge that travels more quickly (Nissen, Kamel, and Sengupta).The internalization flow (D–E) reflects a movement from explicit to tacit knowledge at this organization level. Finally, we include a (reverse) socialization flow from Points E to B (i.e., tacit knowledge moving from the organization to the group level) to complete the one loop (Nissen 2006).

Knowledge flows over space and time are affected by these four dimensional factors. Tacit knowledge gained through experience and learning takes longer to acquire

than explicit knowledge obtained codified in the form of a written manual, and much longer than information or data. In addition, the more people within the organization required to obtain the knowledge the longer the process. Generally, the rule of thumb is that the longer it takes to acquire knowledge, the more tacit the knowledge is and much richer for enabling action (Nissen 2006).

L.   ORGANIZATIONAL LEARNING

Organizational learning is the influx of new knowledge in specific competitive fields that promotes an organization to gain competitive advantage (Edmondson, 2008). However, producing and processing knowledge has become a central challenge to organizations (Schulz, 2001). There are narrow concepts as to what organizational learning is or the proper method for implementation. Scientists and educators think of organizational learning as an intentional process directed to improve effectiveness. Enhancement of organizational effectiveness must occur to claim organizational learning has taken place (Huber, 1991).

Learning refers to knowledge in motion, the movement of knowledge between people, organizations, places, and times, as it is a characterization of creation or acquisition of new knowledge. However, it is only in the perspective of the individual to consider knowledge as new (Nissen 2006). Similarly, Nonaka (1991) states that rather than focusing on learning, he focuses on knowledge creation as a subset of learning. Knowledge flows within an organization are expected to be highly functional in the sense that they contribute to value that is readily identifiable. Knowing and learning are tightly interrelated activities and strongly connected by the knowledge-based activity of doing.

Huber (1991) provides us with his understanding of organizational learning. He elaborates on four constructs that integrally link to organizational learning (knowledge acquisition, information distribution, information interpretation, and organizational memory). Intentional learning is a focal process of organizational learning for scientist and academics, which tends toward improving effectiveness. It is important to challenge these concepts since narrow conceptions decrease the chances of discovering useful

findings or ideas. Learning does not always increase the learner's effectiveness or potential effectiveness but instead, learning may result from new and significant insights and awareness that attain no behavioral change. The critical element in learning is that we can be consciously aware of differences and alternatives for our own choosing. The choices may not tend to reconstruct our behavior but rather change one's cognitive maps or understandings (Huber 1991).

Edmonson (2008) places emphasis on execution-as-learning approach to organizational learning that promotes success over the long haul. A company that constantly evaluates its activities, discovers means of improvement with a built in mechanism learning as an expectation, can become a successful and adaptive organization. Edmonson (2008) states there are four unique day-to-day approaches of execution-as-learning. First, use the best knowledge obtainable to inform the design of specific process guidelines. Second, enable employees to collaborate by making information available when and where it is needed. Third, regularly use a capture process to measure and evaluate the accomplishments of work. Fourth, study the collected data in an effort to find ways for improvement. These four practices become the basis of a learning infrastructure that becomes the backbone of the organization, making continuous learning part of the daily routine.

Edmonson (2008) explains how the best organizations have figured out how to learn quickly while maintaining high-quality standards. Fostering psychological safety provides a means necessary to ensure avoiding penalization when asking for assistance or admitting a mistake. Psychological safety is crucial within organizations where knowledge constantly changes, where employees need to collaborate, and where workers must make decisions without intervention from the management. One should realize that no one could perform perfectly in every situation when knowledge and best practices change regularly. Psychological safety does not operate at the expense of the employee's accountability (Edmondson, 2008). The most efficacious organization can achieve high levels of both accountability and effectiveness as shown in Figure 11 as adaptive from Edmonson (2008).

Accountability for Meeting Demanding Goals

		Low	High
Psychological Safety	**High**	**Comfort Zone** Employees really enjoy working with one another but do not feel particulary challenged. Nor do they work very hard.	**Learning Zone** Focus on collaboration and learning in the service of high performance outcomes
	Low	**Apathy Zone** Apathetic employees and their time in competition of one another. Motivation is for personal gain than to share ideas.	**Anxiety Zone** People fear to offter tentative ideas, try new things, or ask collegues for help regardless of knowing that success requires all

Figure 11.   Organizational effectiveness (After Edmonson, 2008).

Organizations that adapt to an execution-as-learning model do not place their focus on being more effective than competitors, but rather on faster learning. The goal is to discover what works and what does not. Employees must obtain new knowledge while executing. Edmonson's research (Edmondson, 2008) describes four steps to accomplish this objective:

Step 1: Provide Process Guidelines. Establish best practices gathered from experts, publications, and competitors. Not necessarily produce efficiency, but to promote organizational learning. Most effective knowledge organizations recognize that best practice is an evolving process only succeeding when employees are adaptable.

Step 2: Provide tools that enable employees to collaborate in real time. Regardless of the effort in planning, knowledge learning in an organization requires people to make parallel collaborative decisions in response to unanticipated, unique, or complex problems. Facilitating collaboration is critical in a knowledge environment. Successful organizations provide forums to build networks and training in team skills, which foster important areas of expertise and responsibility, together.

Step 3: **Collect process data**. Capturing performance measurements provides the critical data to understand how the current performance is accomplished. A system approach to capture and implement periodic refinements to ongoing processes provides valuable feedback.

Step 4: Institutionalize disciplined reflection. The analysis of collecting measurements is to understand what goes right and what does not to prevent failures and make improvements. After refining the processes, reflection is necessary to ascertain if there was a reduction in failures or realized improvements. This can be a difficult for organizations to implement since it may cause a disruption in procedures causing uncertainty, and difficulties with people accepting change.

Fostering an atmosphere in which mutual trust and respect thrive is imperative for execution-as-learning. Managers should empower rather than control, ask the right questions instead of giving the right answers, and focus on flexibility instead of insisting on adherence. When employees realize their ideas are welcome in psychological safety, they will offer innovative ways to improve the quality of their organization thus establishing a firm foundation for the organization's success (Edmondson, 2008).

M. FEEDBACK LOOPS

To understand how knowledge flows within an organization can provide insights as to the current state of knowledge. Complementary to Nissen's multidimensional approach to knowledge flows, Sterman (2000) describes that effective decision-making and learning require us to become system thinkers using feedback loops. Systems thinking is the ability to see the world as a complex system, in which we understand you cannot just do one thing to solve a problem, and everything has a connectedness. Systems dynamics is a method to enhance learning in complex systems. Because we are concerned with the behavior of complex systems, system dynamics draws on cognitive and social psychology, economics and other social sciences (Sterman, 2000).

It has long been acknowledged that people seeking to solve a problem often make it worse. Policies may create unanticipated side effects. Attempts to stabilize a system

may actually end up destabilizing it because the decision may provoke reactions by others seeking to restore balance initially made upset (Sterman, 2000).

As an example, Sterman (2000) considers the birth rate in Romania in the late 1960s. The birth rate for Romania was approximately fifteen per one thousand people. For various reasons, the government considered low birth rate a serious problem. The government responded with policies to stimulate the birth rate: banned importation of contraceptive devices, propaganda campaigns encouraged large families, modest tax incentives for larger families, and banned abortion.

The result was immediate and dramatic as the birth rate rose to nearly forty births to every thousand. Government officials relished in their apparent success of their new policies. However, nine months later the birth rate began to fall again; four years afterward, the birth rate dropped to twenty, and by 1989, the birth as back to where it began prior to the implementation of the new policies to increase the birth rate (Sterman, 2000).

The cause of the birth rate drop after a sudden increase was because people found ways around the policy by using smuggled contraceptives, and women sought back-alley abortions. In the first few years of the new policies, deaths from complications of abortion tripled; neonatal deaths rose three hundred percent, and a twenty percent increase in infant mortality rate occurred. The policy became ineffective almost immediately after implementation (Sterman, 2000).

The policy did not address the issues of why there was a paltry birth rate. People were having small families because of limited childcare, families lived in crowded tiny apartments, scare jobs and the consistently low incomes. Unfortunately, the children suffered the most from the population policy. Orphanages were overcrowded; child health care and services were over-stretched and limited, and HIV and AIDS became an epidemic due to reused needles in medical treatment (Sterman, 2000).

System dynamics is an important aspect of KM and knowledge flows within an organization. People often do not understand the full range of influences that may affect

knowledge life cycle and the numerous potential outcomes as a result. As presented above, the decisions made in an organization to manage knowledge creation, flows and learning may trigger unexpected side effects. To assist with making KM decisions one must understand the feedback processes, stock and flow structures, time delays and the nonlinearly of events (Sterman, 2000). The most complex behaviors of knowledge usually arise from the interactions among the components of the system, not from its complexity.

The dynamics of systems consist of an interaction between just two types of feedback loops, positive (self-reinforcing) and negative (self-correcting) loops. Positive loops keep the action continuing in one direction whereas negative loops create a balance. Figure 12 demonstrates an example of a positive loop and negative loop. In the negative loop, training requirements increase training; however, an increase in training reduces the requirement for required training (the more people are trained, the less people need training), which reduces training. The negative loop is balanced because it is continuously correcting. In the positive loop, learning increases knowledge, which in turn promotes learning. Alternatively, reduced knowledge reduces learning which in turn reduces knowledge. The positive loop is re-enforcing and will spiral indefinitely in the same direction.
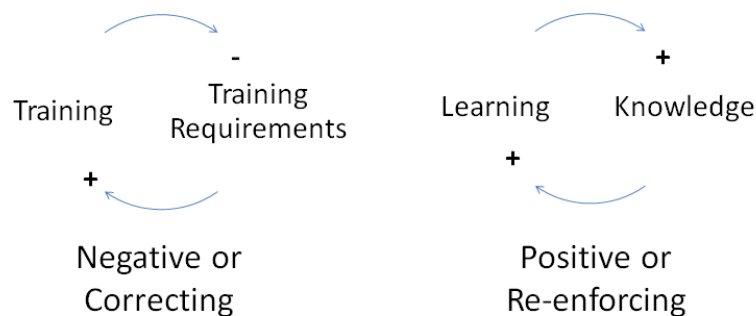
Figure 12.   Feedback Loops (After Sterman, 2000)

Although mapping feedback loops for a particular process or operation can become complex, it provides an understanding of counter intuitive influences that exists beyond immediate observation. In a knowledge environment, understanding influences

knowledge through feedback loops provide an opportunity for analysis and implementation of positive change for improved knowledge flows and situational awareness.

III. METHODOLOGY

A. INTRODUCTION

There are circumstances in a Coast Guard C2 COMCEN watch environment where watch members experience a loss of situational awareness from one watch to the next. The consequences of these circumstances are a result of the loss of explicit and tacit knowledge during a watch changeover. This gap in knowledge can cause degradation of C2 performance and drastically affect operational response times to urgent situations. The Coast Guard has not yet explored the unique circumstances surrounding knowledge management and organizational learning in a C2 COMCEN watch environment or its effects during normal watch routines.

This study undertakes qualitative fieldwork through a ground theory method for examination and discovery of how the Coast Guard C2 organization manages its knowledge resources. The design examines the patterns and details of work processes concerning knowledge flows across a C2 watch environment and discovers how it affects situational awareness for decision-making. The study is an iterative process of interviews and observations to collect the data necessary to conduct an appropriate analysis. The literature review chapter provides historical information on previous studies and theories, which provides a conceptual lens for guidance. However, the researchers do not have advanced personal knowledge of the individual participants or the C2 environment that may introduce a bias. Due to the nature of the qualitative work in this paper, the study is not attempting to offer an analysis on the quality or measure to emphasize cause and effect. Instead, the study examines the knowledge influences in the organization that may result in a causal effect.

The practical significance of this study is to: 1. Examine the current knowledge state of the C2 COMCEN. 2. Identify the influences that lead to the cause of knowledge maturity and knowledge flows. 3. Reach a conclusion to answer the research questions. 4. Provide recommendation for future studies.

B. RESEARCH QUESTIONS

The study focuses on examining the C2 COMCEN for the following questions:

    1.   Primary Research Questions:

        a.   How does knowledge flow within the C2 organization?

        b.   How do knowledge flows affect the transfer of situational awareness knowledge from one watch-stander to another?

    2.   Secondary Research Questions:

        d.   What behaviors within the organization may contribute to the loss of knowledge?

        e.   What are the influences that affect the organizational knowledge culture?

        f.   How can the Coast Guard improve C2 situational awareness of what it learns from the unit's knowledge flows?

C.   PROCEDURES

    1.   Location

Coast Guard District Eleven Command Center, Coast Guard Island, Alameda, California.

    2.   Participation Requirements:

- Must be an active or reserve Coast Guard member.
- Must be a Coast Guard Civilian Employee.
- Must be assigned for duty to the District 11, Command Center watch located at CG Island, Alameda, CA.
- Must consent to participate in the study.

3. Process

The researcher will conduct a knowledge audit in accordance with the knowledge audit process in paragraph C, 4. Approximately twenty participants are available to participate. The researcher will select participants from the available watch-standers on duty. All potential participants will attend a full disclosure brief on the study and be given the option to volunteer. The data collected will remain private and anonymous. In addition to official duties, the participants will answer interview questions and explain details of their work processes related to knowledge flows and work environment. The study will take place during the normal course of their command center watch duties. Private interviews conducted on the watch floor during times coordinated with the watch supervisor on a not to interfere with basis.

4. Knowledge Audit:

Knowledge audit is a critical knowledge management methodology to identify an organization's current knowledge status. It is important for senior management to understand the strengths and weaknesses of their knowledge position to manage their knowledge economics. Knowledge economics allows one to allocate scarce knowledge resources. Knowledge clumps, clots, gaps, best practices are issues that affect knowledge scarcity and influence an organization's ability to use knowledge efficiently. A knowledge audit can serve as a basis for evaluating current knowledge performance and suggest changes for improvement. It examines the amount and source of knowledge to find an effective method of storage and dissemination. A knowledge audit is a planning document that provides a structural design necessary to address the specific knowledge details (either qualitative or quantitative) (Liebowitz, Rubenstein-Montano, McCaw, Buchwalter, & Browning, 2000). Knowing what data to collect for a particular organization is critical to obtaining relevant information for analysis. Then, the data collected and measured has to reach an appropriate level of saturation for the auditor to assemble a reasonable knowledge assessment.

It is also important for a manager to understand the effectiveness of processes. One only needs to ask pertinent knowledge questions in relations to organizational business: Are employees following procedures out of bad habits or are they conducting periodic reviews and measurements to ensure up-to-date processes for improvement? In addition, is it difficult to find an expert to answer a question or address a specific problem? The study will consist of the following knowledge audit steps:

- **Interviews**: Appendix A contains an adapted list of recommended KM audit questions from Liebowitz, Rubenstein-Montano, McCaw, Buchwalter, and Browning, (2000). to acquire data either through observation or interview questions.

- **Survey**: Appendix B contains a list of survey questions to obtain statistical data for analysis.

- **Knowledge** Map: Develop a knowledge map to display the relationships of knowledge and knowledge flows between people and IT systems.

- **Knowledge Flows**: Ascertain where and how flows within the organization.

- **Analysis of statistical data**: Several charts and graphs describe the results of the statistical data and inferences established from obtained observations, interviews and the survey.

- **General analysis**: Contains a description of organizational knowledge behavior and processes that incorporate each stage of the knowledge hierarchy such as the generation, learning and sharing of organizational knowledge.

IV. ANALYSIS

A. INTRODUCTION

The analysis presented in this chapter is a result of data collected from months of private interviews and observations acquired from the Coast Guard Eleventh District (D11) C2 COMCEN located on Coast Guard Island, Alameda, California. The first part of the analysis describes an overview of the D11 organization and a depiction of its mission responsibilities. A description of the D11 organizational chart delivers a broad view of the senior command hierarchy with a focus on the C2 COMCEN branch. A description of each position within the branch explains the watch-standers' responsibilities, hence the dependence on KM to accomplish their goals.

The knowledge examination of the C2 COMCEN follows the organizational overview and begins with describing a roadmap of knowledge relationships that produce situational awareness. In addition to the knowledge sharing processes, many other circumstances influence how situational awareness evolves. The knowledge roadmap identifies several critical knowledge factors responsible for supporting knowledge flows and the development of situational awareness. A description of each knowledge factor provides the reader with an understanding of what influences and affects the organizational knowledge processes.

As with most organizations, the challenge is to transfer rich and powerful knowledge with enough quality to sustain situational awareness and enable action. Unfortunately, situational awareness sustainment is not always achievable, as it remains susceptible to decay. The analysis further describes, locates, and explains knowledge related issues within the organization that weakens knowledge, but recognizes where improvements are possible.

At the conclusion, a knowledge map with a basis in feedback loops provides the reader with insight on influential relationships. The knowledge map serves to guide management with constructing organizational knowledge improvements. The map can

help locate where to implement change and what factors affect or become affected by the change. In addition, the map can deliver an analysis of feedback loops to assist with mitigating unintended side effects.

B.   ORGANIZATION OVERVIEW

1.   Mission

D11 C2 COMCEN has the responsibility to serve as the District Commander's direct representative in the execution of all Coast Guard missions and act as the Rescue Coordination Center (RCC) within its AOR. The C2 COMCEN takes a leading role in gathering intelligence, obtaining situational awareness, and planning with the execution of Coast Guard missions and a supporting role with partner agencies. It has authority to call upon numerous operational resources and coordinate with other Coast Guard units, partner agencies and the maritime community. Key missions as directed by the Commandant of the Coast Guard include (U.S. Coast Guard, 2007):

- Search and Rescue

- Marine Safety

- Aids to Navigation

- Ice Operations

- Marine Environmental Protection

- Living Marine Resources

- Law Enforcement

- Illegal drug Interdiction

- Migrant Interdiction

- Ports, Waterways, and Coastal Security

- Defense Readiness

2. Organization Hierarchy

The D11 Commander, and four divisions of staff personnel comprise the organizational hierarchy. The C2 COMCEN location is within the District Command Center section under the Response Division. Figure 13 displays the D11 organization chart:
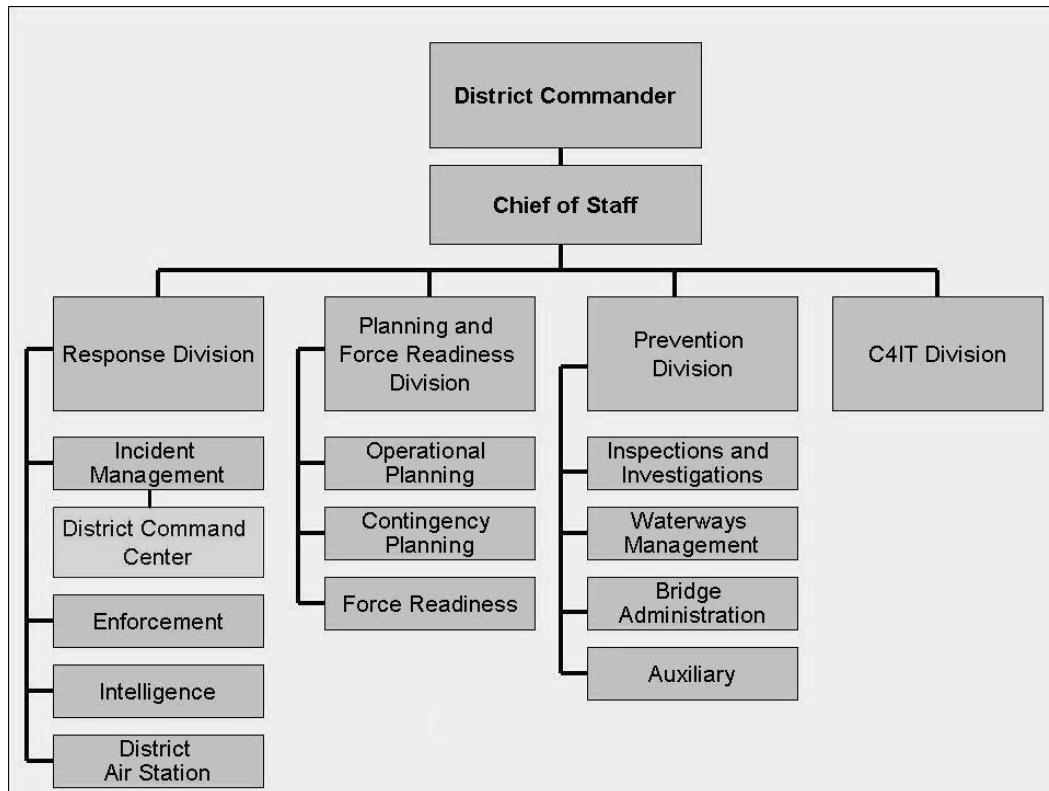
Figure 13.   Commander District Eleven organization chart (From U.S. Coast Guard, 2007)

Division Chiefs: The senior staff encompasses senior officers, each designated as a subject matter expert in a certain field. The division officers manage operations, policies, and plans for its specialized missions within D11 AOR.

C2 COMCEN: The C2 COMCEN branch is a collaborative collection of highly trained personnel working to obtain situational awareness and execute operations. C2 COMCEN is responsible to provide guidance on COMCEN operations and policies to facilitate daily activities. The D11 COMCEN chief also acts as D11 SAR Mission

Coordinator (SMC) The C2 COMCEN chief staffs the watch with four watch-stander positions: The Command Duty Officer (CDO), Operational Unit Law Enforcement (OU-LE), Operational Unit Search and Rescue (OU-SAR) and the Situational Unit (SU).

Command Duty Officer: Provides oversight and coordination of all operational missions within D11 AOR. The CDO presents daily operations brief to the D11 Commander and senior staff members. Ensures COMCEN watch personnel, Sectors and all other operational units involved understand their tasks. CDO ensures proper execution of tasks while remaining aware of the evolving operational picture with the ability to deviate from the plan in anticipation of emerging threats, needs and circumstances. The CDO oversees the interactions between subordinates and other high unit COMCENs. Interacts and supervises the COMCEN responses to inquiries from higher authorities, other agencies, the media, and the public. The CDO requests and coordinates other department personnel and assets as necessary.

Operational Unit – Search and Rescue controller (OU-SAR): Primary responsibility is to ensure that all SAR conducted within the D11 AOR, executes as thoroughly as possible to meet all required mandates. OU-SAR tracks and monitors all active SAR cases throughout the D11 and Pacific Maritime Region. When necessary, the OU-SAR plans SAR operations for active cases under his or her responsibility. The OU-SAR assists and supports subordinate districts and sectors with operational cases when necessary. As the SAR expert, the OU-SAR makes SAR response recommendations to the CDO and the SMC.

Operational Unit – Law Enforcement controller (OU-LE): This OU's primary responsibility is to conduct or coordinate law enforcement operations within the D11 AOR in accordance with congressional mandates and Coast Guard doctrine. Law enforcement duties include prosecuting counter narcotics cases, prosecuting alien and migrant interdiction, prosecuting commercial fishing violations, and prosecuting violations of the maritime boundary line, exclusive economic zone, and territorial waters.

Situation Unit controller (SU): The SU's primary responsibility is to oversee maritime domain awareness for all maritime safety issues such as Port Security, Maritime

Environmental Response, Marine Environmental Protection, Defense Readiness, Ports, Waters and Coastal Security and Aids to Navigation.

C.   KNOWLEDGE AUDIT ANALYSIS

1.   Knowledge Audit Overview

The examination of what influences knowledge, identifies knowledge processes, and discerning knowledge flows became apparent during the course of this examination. Through study, observation, and time, the emergence of knowledge categories appeared. The different knowledge categories and their eventual effects on situational knowledge lead to the creation of an organizational knowledge roadmap, Figure 14. It serves to facilitate and foster a systematic approach of analysis. Each category identifies and groups common characteristics of knowledge maturity, the knowledge life cycle and knowledge flows.

The roadmap provides a visual display overview of each of the knowledge areas in the analysis. The knowledge areas are outlined below with a detailed audit analysis in the following sections of this chapter:

Environment: The environment either supports or inhibits an organizations trust psychology. It contains attitudes and relationships from peers and management that can either encourage or hinder knowledge generation, sharing and situational awareness.

Distractions: Distractions in many forms inhibits the flow of knowledge and maturity during moments of knowledge generation, formalization, and sharing.

External Knowledge: External experts offer a unique capacity for knowledge with the potential to affect situational awareness. The desired result ultimately leads to an action or decision. Coast Guard personnel may not have the appropriate experience and knowledge for the best response under certain circumstances.
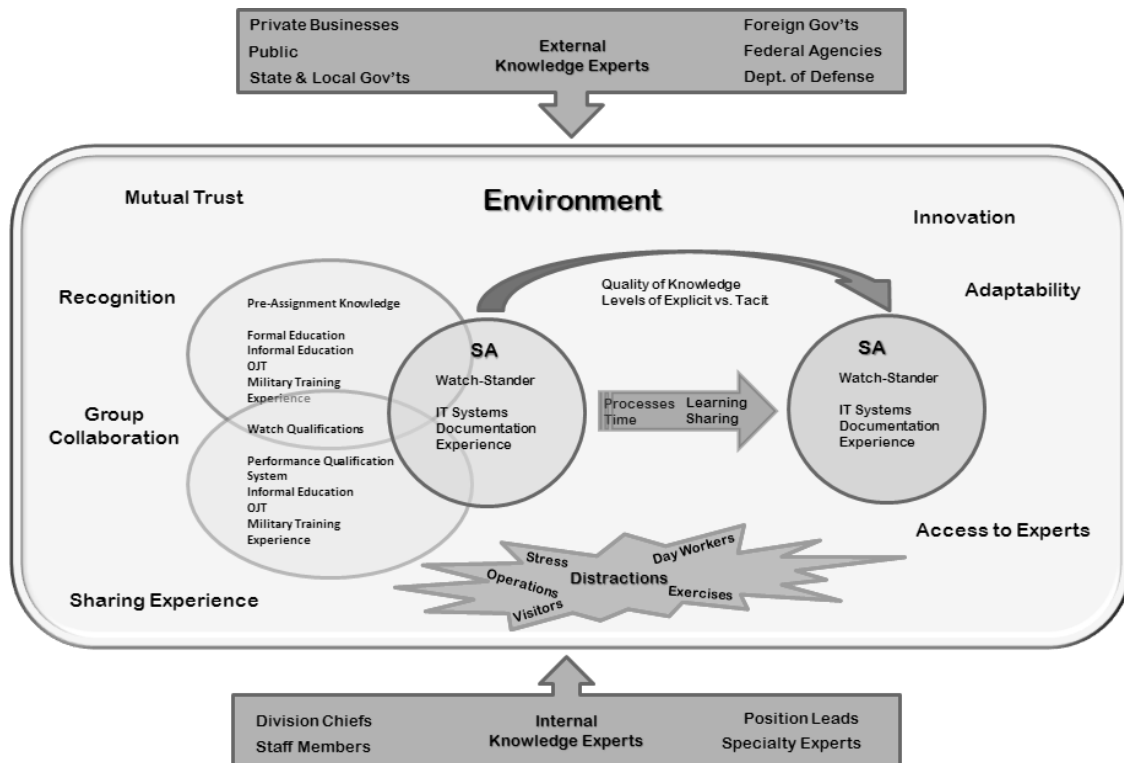
Figure 14.　　　C2 COMCEN knowledge roadmap

Internal Knowledge: Internal knowledge experts deliver the most valuable tacit knowledge for the organization. Although this is where knowledge clumps and sometimes clots. Without the proper knowledge management, expert knowledge may stagnate. The sharing of an experts' knowledge is not normally part of the day-to-day routine, however, is usually available upon request.

Pre-Assignment Knowledge: Each watch-stander has a certain level of knowledge from previous education and experiences. This knowledge is the foundation from which a watch-stander determines required knowledge to qualify in one of the four COMCEN watch positions.

Watch Qualifications Knowledge: Watch-Standers acquire knowledge and experience during the qualification process from several methods, both formal and informal.

Quality of Knowledge: The quality of knowledge (explicit and tacit inclusive) is a culmination of all knowledge influences. Explicit knowledge is easier to transfer to another than tacit knowledge by using written notes and IT systems. However, tacit knowledge, which is difficult to articulate, is more powerful and provides better insight for situational knowledge.

Watch Relief Process: The process of transferring knowledge from one watch-stander to the next for sustaining situational awareness transpires during the watch relief process. This discussion takes place in Section D.

2.   Environment

As discussed in the literature review, the COMCEN work environment has a direct influence on the maturity and flows of knowledge. The environment affects a person's experience and perspective. A watch-standers' attitudes and interactions with others affect their ability to share knowledge. In addition, internal and external tangible activities occur during the watch that affect knowledge generation and sharing. This study examines the different issues regarding work relationships between peers, management, and other factors that either encourage or inhibit knowledge economics.

To develop an understanding of the D11 C2 COMCEN work environment and its possible effects on its knowledge culture, a survey (Appendix B) provides the following data in a radar chart Figure 15. The survey asks watch-standers and management questions to rate a response between 0 to 5 (low to high). The questions cover three areas of the watch environment: Watch-stander to peer relationships, watch-stander to management relationship, and access to experts or IT systems to facilitate knowledge.

Overall, the results of the survey from watch-standers show an environment conducive to knowledge maturity and sharing since most responses were above a moderate rating. The low rated questions (also regarded as the most needed for improvement) were KM effectiveness, adaptability, and use of IT systems. However, adaptability is intriguing because it represents the ability for the organization to change. The senior watch-stander for each position (called the position lead) is responsible for

implementing change. Watch-standers submit a request for change to the lead person, then onto the senior watch board for review. The appropriate Division Chief approves the change where it becomes an organizational policy. However, watch-standers complain the process is too lengthy and that most requests fall into a black hole. Many watch-standers resist change, making it a challenge to standardize procedures thus affecting the transfer of explicit knowledge.
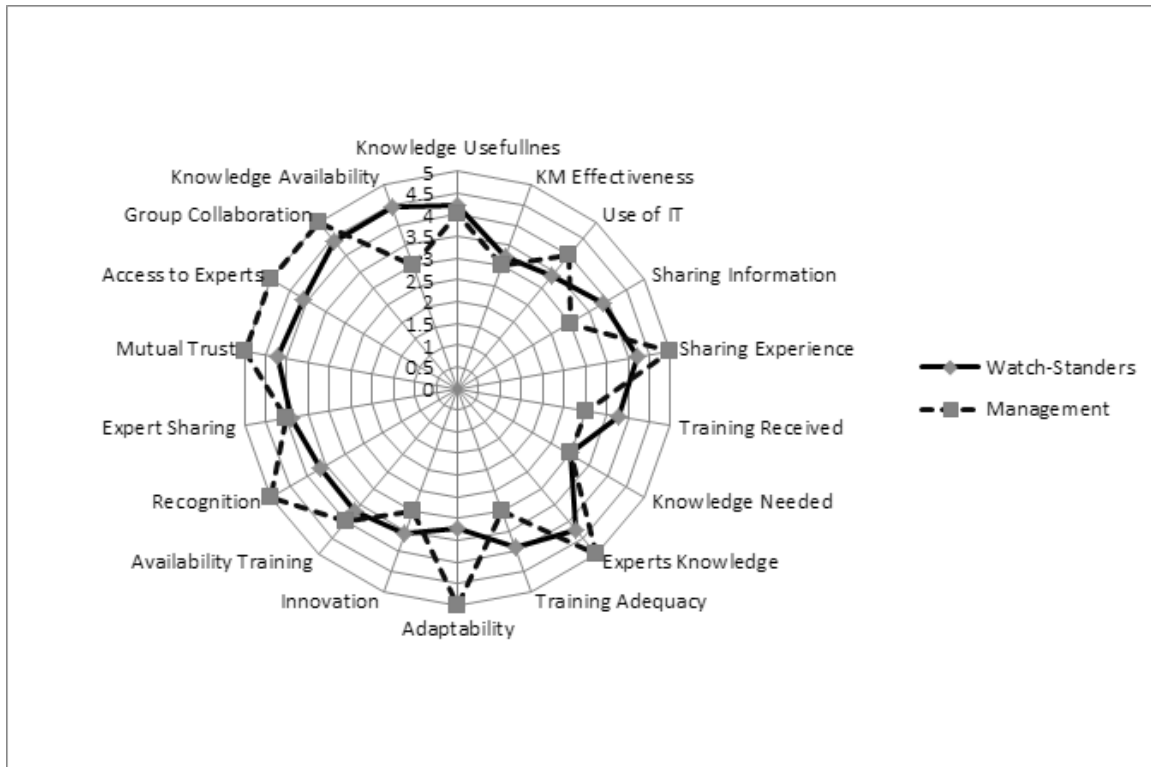
Figure 15.   C2 COMCEN watch environment survey results

The survey questions having the highest rating were; experts' level of knowledge, group collaboration, and availability of knowledge. In general, watch-standers take satisfaction with their access to internal knowledge and their ability to work well together. The workspace environment is open with each OU position close enough to facilitate knowledge sharing but not too close that they cannot work privately. The position-seating environment encourages collaboration and socialization. Conversations, interviews, and observations support the rated responses of the survey.

There are striking differences between the management results and the watch-standers. Management perceives the work environment in a better light than the watch-standers. This should not strike anyone as unusual since leadership views the environment they manage in a different lens than those that work in it. The top two issues with the widest separation are personnel recognition and adaptability to change. Management appears highly satisfied and opines that no improvement is necessary, whereas the watch-standers view this as an area of needed improvement. There was not enough data to support either conclusion other than to say bias plays a large role in personal perspectives.

3. Distractions

During the daylight work hours, several other distracting factors hinder knowledge sharing and situational awareness. The COMCEN operations are typically more active than night hours because most people are active and working during this time. In addition to working active cases, the watch-standers respond to internal and external inquiries, (e.g. Media, local government, and mariners) and provide situational awareness briefs. Visitors (personnel not assigned to the COMCEN) enter the space to conduct necessary business. However, the meetings with non-watch personnel occasionally require interaction from other watch positions.

Interviews and observations reveal COMCEN distractions as frustrating and hinder one's ability to work effectively. At times, random people enter the watch space (forgetting the space is an active C2 COMCEN) and engage in open conversations or competing for attention with other OU positions. However, at times, there are personnel available to help alleviate the extra work during prolonged periods of high operational tempo.

Several other factors distract watch-standers and affect knowledge flows. Occasionally requests for information external to the C2 watch such as private business, professional services, media, outside governmental agencies and the public result in delays or lack completeness. Situational awareness requires real knowledge in real time.

Several watch-standers made the comment of spending too much time and effort to obtain necessary information while attempting to maintain complete attention to the case. These efforts distract from the watch and at times convolute and confuse situational awareness until resolution.

4. External Knowledge

Access and collaboration among sources of knowledge external to the C2 COMCEN environment is critical to acquiring situational awareness. Maritime domain awareness relies on external knowledge for details about a case or incident. Details, no matter how obscure, make the difference between life and death or millions of dollars in property or environmental damage.

The public provides knowledge from four fronts. 1. The people personally involved in the situation. 2. Eyewitnesses. 3. Proximity to the situation and ability to participate. 4. Specialty experts such as academics. The C2 COMCEN supports collaboration with the public through the efforts of encouraging positive interactions and meaningful exchanges. The public contacts the C2 COMCEN regularly to report cases or incidents and inquire about maritime concerns. Since most of the DoD military closed their bases in the San Francisco Bay over the past 20 years, the C2 COMCEN is often the point of contact for national defense issues. Communication with the public is via telephone, e-mail, and maritime related websites.

The C2 COMCEN CDO often provides details of a case or incident as the representative of the D11 Commander to the media. Communication usually takes the form of a telephone interview or via e-mail. However, the COMCEN learns much from the media as they will have access to information not yet acquired by Coast Guard investigators. The collaboration of sharing knowledge not only provides news for the public but also may provide valuable knowledge for C2 situational awareness.

D11 command staff collaborates with many U.S. federal agencies and the DoD as well as foreign governments. Sharing knowledge and resources help to accomplish U.S. mandates of homeland security and homeland defense. Especially where blending of

jurisdiction is mutually beneficial. The C2 COMCEN serves as a means of communication and a place to coordinate operations. Expertise, intelligence, and joint operations of the diverse communities foster positive relationships and enhance situational awareness. Although the relationships provide an environment of mutual trust, cultural differences can affect knowledge sharing. Not unlike many organizations, agencies tend to protect details of their internal operations, procedures and policies. In some situations, organizational culture may inhibit sensitive knowledge that may be beneficial to all involved.

Watch personnel occasionally experience difficulties sharing knowledge with external sources. The D11 COMCEN has a responsibility different than the other three districts in the Pacific Area AOR. The D11 COMCEN acts as the Pacific Area COMCEN as issues arise. This places an additional burden on the COMCEN and places one District over another known to create cultural animosity by other District COMCEN. Several personnel desire an additional watch section specifically for a Pacific Area representative to manage Pacific Area cases and monitor cases of all subordinate Districts. Watch personnel believe the benefit will standardize practices among Districts and encourage knowledge sharing. Organizational culture creates an environment where District COMCENs prefer to work in isolation and only share with other District COMCENs when necessary. Not because sharing is beneficial, but because it is a requirement to do so such as when cases cross district AOR boundaries. Watch personnel also share difficulties working with subordinate Sector units. Experience with the Sectors lead to the perception that they prefer to work independently and only provide information when requested or is a predefined requirement. Several watch personnel express the difficulty of receiving briefs and reports on active cases. This belief has a basis on personal interaction between the District COMCEN and the Sector COMCEN. D11 COMCEN watch personnel have the impression (from the Sectors) that information flows to the District COMCEN from the sector serves only to create more work for the sector with no benefits.

5. Internal Knowledge

Internal knowledge with the D11 command typically flows without restraint among the employees but not without its problems. Specialty experts at the division level clump knowledge within their group of personnel. Experience provides tacit knowledge that remains clumped until needed by the C2 COMCEN personnel. Tacit knowledge is difficult to articulate and takes time to codify into knowledge for sharing to others. Other than policy, procedures, and doctrine, much of the knowledge remains in reserve and accumulates in one's mind unless requested. Sharing explicit knowledge is relatively straightforward. Asking a direct question and receiving a direct answer often suffices to accomplish a goal. However, sharing tacit knowledge requires socialization, which is not common between watch-standers and staff personnel. Many C2 COMCEN staff members express their concerns that there is much more to learn from experts, however, not knowing what the experts know, and what questions to ask, reduces knowledge flows.

Sources of knowledge in the surrounding geographical area do not share knowledge as well as expected. The D11 COMCEN exchanges and monitors subordinate units' cases or uses their resources for events or incidents. However, organizational behavior and culture can inhibit knowledge flows. Although collaboration sustains at acceptable levels for the success of missions, limitation of knowledge flows still exist. The senior command will often only supply explicit knowledge to the subordinate unit to accomplish the goal. Whereas the subordinate commands provide explicit knowledge to the senior command based on what they believe to be their expectations. Knowledge flows freely within each organization due to mutual trust and organizational behavior. The mutual trust between separate commands is not as strong so the sharing of knowledge has its limitations.

Watch Relief Process: The process to transfer situational awareness from one person to the next using tools at their disposal. . Several processes are available to foster the transfer of situational awareness. However, lack of process optimization can reduce the transfer success of situational awareness. The transference of tacit knowledge usually depends on individuals and their environment.

Ultimately, the study will demonstrate that knowledge influences, processes, and flows will determine the quality of situational awareness. Chapter V will contain conclusions that identify the circumstances behind the transfer of situational awareness and issues involving loss of quality.

6.   Pre-Assignment Knowledge

Senior enlisted, junior officers, or civilian employees with prior knowledge and experience staff the C2 watch-stander operations. C2 COMCEN members report to the unit with diversified backgrounds of knowledge and experience. Shared experiences are conducive to mutual trust and collaborative relationships. The differences of knowledge between them facilitate new knowledge through socialization.

The enlisted personnel are specialty professions with years of experience in COMCEN duties or related fields. Operations Specialists (OS) are experts in communications, tactical operations, C2 COMCEN operations, and SAR controllers. These individuals provide a wealth of knowledge that junior officers or civilian employees may not have. The prior knowledge and experience provide the bulk of knowledge needed for the D11 C2 COMCEN work. However, not all enlisted personnel have the same level of experience and expertise. Knowing is only part of the total knowledge and experience necessary for competence. Since many of the enlisted personnel transfer to the COMCEN from another location of the U.S., their experience lacks local geographical knowledge of the AOR and external knowledge sources. In addition, the specialty expertise does not comprise other knowledge specialties needed for proficiency such as the Marine Science Technician specialty (MST). The Marine Science Technician specialists are experts in port security, marine inspections, and environmental protection. MST specialists reside at the division staff level or the Sector unit where their expertise is beneficial. However, C2 COMCEN requires knowing enough about marine safety and marine environment to coordinate, collaborate, communicate, and monitor maritime cases and incidents. Several watch-standers believe that MST personnel in the COMCEN would give the watch-stander clearer insight and understanding of information he or she receives from external sources.

The LE-OU position requires different knowledge than the SU or SAR-OU positions. Typically, this position requires knowledge and experience in law enforcement matters such as Boarding Officer School and experience as a boarding officer, educated in maritime law, educated and experienced in organizations such as DoD's Northern and Southern Commands and numerous federal and local agencies. The enlisted personnel typically do not qualify as OU-LE controllers because they usually lack the background knowledge or experience.

The Junior Officer (JO) personnel have formal academic education with some operational planning and executive experience. It is characteristic for a junior officer to lack the level experience and knowledge the specialty experts have, but most are familiar with organizational management. Their experiences and training determine where they will initially work and identify additional required training. Unlike the enlisted personnel, JOs will usually qualify and work at each position. JOs use the C2 COMCEN environment to develop competencies for career development.

Civilian employees come from a diversity of backgrounds and experiences. Many have prior experiences with extensive backgrounds similar to enlisted personnel.

7.   Watch Qualifications Knowledge

Watch qualification knowledge is the acquisition of organizational knowledge with the intent to provide minimal standards to perform watch-standing duties. Personnel arrive at the C2 COMCEN with the knowledge brought with them and qualify to stand watch duties by attaining minimal amount of experience and knowledge expected of the job. Occasionally newly assigned personal will attend specialized training prior to reporting on board through a pipeline process.

Watch qualification takes approximately four to five months depending on scheduling, previous knowledge and experience, and operational tempo. Civilian employees become a repository of tacit knowledge since they provide continuity over the years. Civilians do not transfer every two to four years as military members.

Several methods of learning for each watch position vary by knowledge and experience, not by processes.

Oral Qualifications Board: All personnel receive an oral qualifications board by subject matter experts and fellow watch-standers. The purpose is to pose numerous questions and fictional and nonfictional scenarios to test and observe the applicant's responses. The board will either give a certification of qualification or return the applicant for additional training.

Performance Qualification Standards (PQS): Given a watch position, each person must complete a PQS program. Each PQS is a list of knowledge the trainee must learn, master, and demonstrate an ability to perform. Personnel accomplish PQS items through trainer instruction, observation, or self-learning initiative. It is also one of the prerequisites to taking the oral board.

On the Job Training (OJT): OJT is training where the trainee accompanies a qualified watch stander to observe, learn, ask questions and participate in watch duties. The purpose is to provide an interactive sharing environment that fosters learning specialty knowledge with experience to develop tacit knowledge. OJT provides learning in policies, doctrine, procedures, and IT systems. Although the D11 C2 COMCEN states that each trainee shall accompany a mentor, this is not always the case. Several watch-standers state that the diversity of trainers is better for learning because they will receive a variety of knowledge and experience.

Specialty Schools: Specialty schools provide training by subject matter experts in an environment conducive to learning. In some situations, OJT is not sufficient to provide a person with the appropriate knowledge and skills. The National SAR School located in Yorktown Virginia is an example of a specialty school required for all OU-SAR qualified personnel. Staffed by Coast Guard and Air Force personnel, several SAR courses provide the student with knowledge and expertise in maritime search planning, coordination, operations, On-scene Commander, and SAR policies and procedures in coastal and oceanic environments (U.S. Coast Guard, 2012).

8.   Quality of Knowledge

As previously stated, obtaining situational awareness is successful only if the quality of knowledge is sufficient for making decisions and taking action. Each watch-stander is responsible to attain this high degree of knowledge for codification and articulation. The transfer of knowledge from one person to the next is like electrical components that transfer electric power over a wire. Although the components and wire are conductive, the materials have natural resistance that causes a certain amount of power loss. Similarly, some knowledge diminishes when passed from person to person. Upon a watch relief, each watch-stander can only pass to their relief at most what they know. If the quality of knowledge of the watch-stander is scarcely sufficient for situational awareness and then combined the natural knowledge loss during transfer, the new watch person may lack appropriate situational awareness to conduct their duty.

D.   C2 COMCEN ORGANIZATIONAL PROCESS ANALYSIS

1.   Watch Setting

The D11 C2 COMCEN watch is in operation twenty-four hours a day, seven days week. There are four operational positions, CDO, OU-LE, OU-SAR, and SU. Each watch position comprises of a single watch-stander, either Coast Guard service member or Coast Guard civilian employee, with the occasional watch-stander in training. Additional personnel augment the watch during high operational tempo. The C2 COMCEN room is open and spacious with individual access to IT systems and communications devices for their responsibility. Other IT and communication systems surround the space for concurrent monitoring of diverse intelligence feeds and ongoing operations. When a watch-stander is not actively working a case or is not attentive to other on-call situations, they are monitoring information feeds, documenting what they know and sharing knowledge with other watch-standers.

A typical C2 COMCEN watch environment is calm and manageable while watch efforts are regular and continuous. Occasionally, the operation tempo increases due to myriad of planned or unplanned maritime events such as joint maritime exercises, LE

incident, SAR response, or maritime security situation. Response requires acquiring information, planning, situational awareness briefs, decision-making, mission execution, and monitoring.

2.   Watch Knowledge Procedures

Watch positions use IT systems and paper forms as a means of codifying data, information, and explicit knowledge. As a matter of practice, the knowledge repositories only contain required knowledge.

A list of published reporting requirements as a policy to assist watch-standers facilitates knowledge flows between external sources and the COMCEN. The requirements specify what knowledge, from where and who should have it. Otherwise, the typical process of transferring knowledge between senior and subordinate units is via the pull method (specific information as requested) than the push method where units provide knowledge because the other might have an interest. However, internal to the organization, knowledge sharing occurs during the watch, typically with the watch position lead person, during midmonth meetings, and shared e-mail.

OU-LE position relies on archival data by reviewing past situations and intelligence information that can generate new knowledge and sustain situational awareness. Historic information is extremely significant because it gives meaning to current knowledge and influences future situational awareness. The OU-LE requires people to have an extensive knowledge background on events and circumstances. Once qualified, OU-LE personnel usually remains to sustain situational awareness. OU-LE uses pass-down logs and computer applications to record and archive significant issues. The knowledge in this environment is dynamic due to the continuous political and policy changes. Whereas the SAR position manages open cases and rarely refers back to a closed case or incident. Completed SAR cases become historic archives, although sometimes needed for a court case or when details provide information for procedural improvements.

There are quick response cards (QRC) and checklists that deliver procedural guidance for each possible incident scenario. As a matter of best practices, watch-standers must refer to the QRC before taking action. Because of the importance, QRCs require regular updates. If a watch-stander does not take the time to review the QRC, an improper response may lead to unexpected results. This is a common mistake for the experienced and expert watch-stander due to over confidence and complacency.

To avoid problems associated with fatigue, the CDO conducts a fatigue examination of all watch personnel to determine the mental alertness of its watch-standers. Should issue arise, the CDO takes swift and corrective action to ensure a well rested the watch environment. The remedy is at the discretion of the CDO.

Area and District Commanders - along with the senior staff – receive periodic briefs by the C2 COMCEN. All subordinate units provide their situational awareness using a template designed to provide information in accordance with policy. District COMCEN personnel compile the information; ensure its relevance and completeness, and then present according to the schedule requested. There is no training program for presentation although some CDO's provide constructive criticism to briefers. Highly motivated briefers take efforts for improvements such as participating in Toastmasters meetings whereas others manage according to feedback from those with experience.

3.   Watch Relief

Each C2 COMCEN watch position has its own watch relief process. During the watch relief, the off-going watch being relieved may use a watch relief check sheet that contains a description of cases (either detailed or vague). The lack of standardization enforcement (or in some situations no standardization) negatively affects the knowledge transfer process. According to several watch-standers, as long as information regarding open cases and other pertinent information somehow makes it to the next watch, standardization enforcement is not necessary. All the positions use IT systems to some extent for codifying case information. However, most of the knowledge documented is explicit only and there are instances of no standardized format. Other than process

standardization for SAR cases and other incidents, there is no standard for training on how to organize a watch routine for efficiency.

The watch relief is a face-to-face experience with a verbal exchange of explicit knowledge, often referring to the IT systems for details. The watch-stander shares his or her tacit knowledge during the watch relief exchange. Prior to the watch relief, the oncoming watch will learn about all active cases and pertinent information. This provides the oncoming watch an opportunity to ask questions for clarification. However, because it is mostly an exchange of explicit knowledge, it is not until later, after the new watch has generated tacit knowledge that pertinent questions start to arise. Watch relief takes anywhere between 10 and 20 minutes depending on circumstances. Closed cases do not require much more than just mentioning although an active watch-stander will review the documentation for familiarization. Only active cases receive the attention of watch-standers because a closed case is no longer relevant.

Upon watch relief, the new watch stander immediately reviews all active cases, reviews chat boards, watch e-mail, personal e-mail, weather status and other informational items. This takes anywhere from five to sixty minutes depending on circumstances. After twelve hours of watch, it is difficult to have the off going watch stay any longer than it is necessary to relieve the watch. This explains the time and effort necessary by watch personnel to review active cases while on watch versus before watch.

Occasionally, after departure from the COMCEN watch, the relieved watch-stander remembers details about the COMCEN experience not previously passed to the new watch stander. However, this situation does not appear to apply to the CDO. After relieving a watch, the CDO rarely has a situation where he or she needs to call the previous watch to ask for more details. The CDO has the other watch standers to rely on if there are gaps in the situational awareness. Occasionally other watch positions will have to call the previous watch for either more information or the person relieved will call to relay information not passed. However, this usually only occurs when the watch was busy or had numerous distractions. The exception is the OU-LE position, because law enforcement often correlates with changing politics and policies; it is difficult to

grasp the situational awareness and all its implications during a watch relief. At times, conversations to share tacit knowledge during the watch are necessary.

The SU position is the least standardized of all the positions. Watch-standers use IT systems and written notes to codify their knowledge. However, there are no standardized procedures to identify and capture knowledge. Instead, the capture and codification of knowledge from the COMCEN experience, is at the judgment of the watch-stander. The position does not manage cases, but responds to immediate issues and either resolves them quickly or forwards them to the appropriate authority (either external or internal). The watch relief process is at times, at the whim and judgment of the watch-stander. He or she determines what pertinent is to pass on to the next watch and in some cases decides which method to use for documentation. According to several watch-standers, the only requirement for situational awareness is for the oncoming watch to understand the active cases. The time spent reviewing logs, documentation, and historical archives for additional knowledge depend on the proactiveness of the watch-stander and how much situational awareness he or she desires to accumulate.

The interviews offer a consensus that the most effective and efficient watch relief is by the most experienced and intelligent personnel. The combination of tacit knowledge and intellectual capabilities facilitates the watch relief process because they know where to focus their efforts to acquire knowledge quickly and thoroughly. Experienced personnel can immediately identify what information is critical, what questions to asked, and what issues are critical to the case to anticipate possible outcomes.

There are numerous factors affecting a watch relief. Occasionally the C2 COMCEN becomes inundated with people for multiple reasons that exponentially lead to noise, disruptions, and distractions. This creates an environment that is difficult to communicate, articulate, and focus on the relief process. A relief may take anywhere from five minutes to an hour depending on the caseload and the watch environment. Fatigue can lead to mistakes and wrong decisions especially at the end of the twelve-hour watch. The longer the watch relief process takes, the added difficulty it is to work on

current cases. Several watch-stander personnel support the notion that the level of experience corresponds to the level of watch relief.

4. IT Knowledge Systems

At times, it is difficult to communicate or articulate knowledge (internally or externally) because the technology needed is not available or is deficient. For example, Goldwave is software that extracts audio off a recording device. The process is difficult and takes time, sometimes too much time. There is a strong consensus to replace Goldwave with a more efficient system or improve the whole recording and extracting process. Another problem with technology is the inability to provide the SMC or external agency participating in the operation a visual display of the current case or operation. The OU-SAR has to contact SMC for approval of deployment of assets, coordination, or planning of a SAR incident. There are times where SMC orders searches and search patterns over areas not necessary because he cannot see the complete common operational picture. In the past, the watch-stander has had a disagreement with the SMC because the watch-stander had a better view of the situation. It is difficult to explain a situation or incident without the use of video or images. IT systems that share multimedia data would provide additional explicit knowledge if not tacit knowledge of the situational awareness.

It is essential to validate acquired knowledge. There is no standard method of validating or testing the information and knowledge received. How to accomplish this is in the C2 COMCEN varies between watch-standers. Some watch-standers rely solely on their tacit knowledge and experience generating an intuitive response. Other watch-standers prefer to share with others what they learned and how they perceive it. Then they listen for feedback.

5. Organizational Learning

The COMCEN uses several training techniques to ensure watch-standers are current on policies and doctrine and qualify personnel for watch-standing. The process of OJT training takes place during the actual COMCEN watch. Trainees stand a break-in

watch at the appropriate COMCEN position. The qualified watch-stander in the position is responsible for training the break-in watch-stander. The trainee keeps a PQS with him or her during the watch where the trainer will begin to instruct on each PQS subject. The training of the watch has no limitations. The COMCEN chief encourages trainees to learn any knowledge in addition to PQS, to produce a better watch-stander. The trainer instructs on a subject from the PQS then initials it to declare the topic trained and discussed. The trainee does not have to exhibit proficiency at that moment but should review and expand on the knowledge. The time for the trainee to demonstrate proficiency is during the oral qualification board. It is possible for knowledge gaps to exist and is never caught by the board during examination.

The level of OJT varies by the individual conducting the training. The diversity training levels has a basis in the personality, intelligence, experience, and expertise of the trainer. There are individuals that enjoy training and sharing knowledge with openness. Others feel uncomfortable and find it difficult to communicate and share with others thus create knowledge clumps. Several interviews explained that all trainers are not equal; some have more quality than others. An unintended but positive effect of training is that the trainer reviews process and procedures they otherwise would not have done. This review not only reinvigorates knowledge but provides an opportunity for the watch-stander to review for accuracy and improvements. Several watch-stander made statements that they felt uncomfortable during a break-in process because the trainer did not appear interested in training and often avoided detailed answers. The trainee does not have to demonstrate proficiency at the time of training. The trainer will discuss a subject, usually from the PQS, and familiarize the trainee with the required explicit knowledge. It is the responsibility of the trainees to follow-up on the subject for preparation of the oral-board. An occasional OJT trainer would make assumptions on what to train and how well to train it based on a rough personal evaluation of the trainees background. If the trainer knew the break-in watch-stander had previous experience, the trainers would often skip-over or briefly discuss certain topics. Although all OJT trainers have passed the minimum requirements to qualify in their watch position, there is no program to screen the quality of their training.

Numerous personnel confided that required training in the SU position does not align with the skill set of most people in that position. The expertise requirement is more than oil spills, marine safety and communication coordination. The experience and knowledge background of most qualified SU personnel is either communications or SAR. There are no Marine Science Technicians assigned to the COMCEN to provide adequate training and expertise. The PQS covers the topics necessary for the knowledge requirements of the position, but sufficient OJT is necessary to provide the depth of knowledge necessary to be a decent watch stander. However, as part of the training, new personnel work with specific D11 Divisions for instruction and later have access to knowledge experts.

Once a month, the COMCEN provides training for all watch-standers not actively on watch. The management (COMCEN Chief and watch position leads) tailor the training to inform on new policies and procedures or to address a trend that needs attention. Occasionally watch-standers request training in areas of uncertainty such as inconsistent procedural responses, recommendations for improvements or due to a unique situation. The once a month training also serves as a place and time the management can speak with the watch-standers all at once for a face-to-face discussion of pending or future issues. Since the all-hands training incorporates all watch-standers, the training covers just general subjects. Unfortunately, the training is not available to those actively standing the watch. Some of the watch-standers feel training efforts were not adequate to justify their participation when they were not on watch.

Watch position leaders provide monthly quizzes or exercises to keep their skills and knowledge sharp. The purpose is to inform on new policies, procedures, or test the watch-standers on unique scenarios. The difference between the monthly training and the position training is general training versus an individual assignment. A watch-stander receives an e-mail or document from one of the four position leaders with either a quiz or exercise for completion during the watch in a not to interfere with operations basis. The benefit of this training is that it is tailored to individuals and individual watch positions.

E. C2 COMCEN KNOWLEDGE MAP WITH FEEDBACK LOOPS

The C2 COMCEN is a microcosm of a knowledge life cycle. Its knowledge purpose is to collect information and knowledge and convert it into something useful and actionable then disseminate as appropriate. With a KM program, it is difficult to determine exactly how knowledge flows and the location of knowledge clumps where the knowledge gaps reside. On the other hand, it is easier to determine the location of knowledge generation and transference through observation.

Figure 16 is a knowledge map with numerous feedback loops for the reader to understand how knowledge flows within the COMCEN. The ovals represent variables in a feedback loop that affects an aspect of knowledge management. They also identify areas within the knowledge map where gaps, clumps, and holes may exist to either inhibit or facilitate knowledge flows. The arrows represent a connection between two variables. The thick solid lines represent tacit knowledge (or the potential to carry tacit knowledge) that moves slowly from one variable to the next. Tacit arrows represent the highest level of knowledge capable of transfer. It may also carry explicit knowledge or information. The thin arrows represent the transferring at most, explicit knowledge between variables, but at other times may only carry information or data. Dashed lines only indicate an influence or causal effect to the next variable. The dotted line represents the transfer of data and information between variables. The positive signs and negative sign represent the effect of the connection between variables. The positive sign signifies a positive direction, which means as one variable increases, it causes the other variable to increase. This also means that if one variable decreases, then the connected variable will also decrease. The negative sign means the variable will have an opposite effect on the connected variable. The only negative sign on the knowledge map is the variable labeled "distractions." The negative feedback loop demonstrates that when distractions in the COMCEN increase, there is a reciprocal effect on the environment.

This knowledge map provides the reader an understanding of which variables influence other variables and how change can affect situational awareness. According to this map, knowledge is responsible for achieving situational awareness. The model helps

demonstrate the different influences and causes that ultimately affect situational awareness. For example, the more data increases, information will increase, which in turn, allows for more knowledge generation. Another example is that when OJT increases, personal experience will increase causing an increase in learning, an increase in knowledge, and then eventually an increase in situational awareness. This map identifies that an increase in OJT will increase situational awareness. However, because the connections are positive, a decrease in OJT will eventually lead to a decrease in situational awareness. In addition, because each connection displayed is a thick line, the knowledge transferred is tacit knowledge, which takes time as it moves across space. However, the connection between OJT and Knowledge is a thin line that represents the faster movement of explicit knowledge.

The knowledge map with feedback loops can facilitate the organizations KM program by determining where to focus additional knowledge studies. An examination of each variable can provide locations for a SWOT (Strength, Weakness, Opportunities, and Threats) analysis; determine knowledge clumps, clots, and sinkholes. The map can also provide locations of where to take measurements to monitor knowledge flows, capture trends, and decide on improvements.

Figure 16.   C2 COMCEN knowledge map with feedback loop relationships

V. CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY

This chapter summarizes the purpose of the thesis and discusses the methodology used to conduct the study. In addition, the chapter contains conclusions drawn from the Alameda C2 COMCEN knowledge audit and of research questions annotated in this paper. Finally, the thesis ends with recommendations and suggestions for future studies.

The Coast Guard C2 COMCEN organization is responsible for managing its missions and operations within is geographical AOR. The key element to accomplish this goal is to ensure a high quality of situational awareness from knowledge and information it acquires. Through the course of a standard watch cycle, watch-standers obtain knowledge and experience as they manage operations, share with others, and respond to cases or incidents. The knowledge and experience a watch-stander generates and accumulates travels through a maturing process of the knowledge life cycle thus aiding the development of tacit knowledge. Although it requires time to generate tacit knowledge, it is rich and powerful and helps to achieve sufficient situational awareness that enables action. Management suspects that—during the course of the watch or the watch-relief process—knowledge is vulnerable to constraints or degradation thus affecting C2 COMCEN's ability to operate effectively.

The purpose of this study is to examine the C2 COMCEN environment by making observations and conducting interviews for achieving an understanding of what influences knowledge quality. It is necessary to identify where knowledge originates, who has what knowledge, how knowledge flows, and which influential relationships enable a successful situational awareness. The literature review in Chapter II aids the study by providing the current knowledge research and studies from leading experts in the knowledge field. This knowledge supports the study by providing an explanation of knowledge mechanics, recommending knowledge audit procedures, and providing unique perspectives and knowledge insights.

B.   CONCLUSION

The study examines organizational knowledge behavior through a knowledge audit process in an attempt to answer several research questions stated in Chapter 1.

The gravity of situational awareness and the effects of its many influences (feedback loops) determine knowledge flows within the C2 COMCEN organization. The knowledge roadmap from Chapter IV provides an understanding of knowledge sources and intermediary issues to promote or hinder knowledge flows. The quality of knowledge passed to the new watch-stander depends on several factors. This begins with the knowledge already known from previous education and experiences. Next, it includes knowledge and experience learned on the job. External information or knowledge from participants or eyewitness accounts is paramount to knowing the current situation. In addition, obtaining expertise from external specialty sources enriches knowledge and enhances the ability to take action. Another determinant factor is the process of transferring the knowledge, such as sharing the experience, case checklists and using IT systems. However, it is vital to note that the total knowledge and experience of an oncoming watch-stander also affects the ability to understand the quality of knowledge.

The knowledge map identifies knowledge flows from specific sources. Tacit knowledge takes time to formulate and transfer while explicit knowledge travels quicker, but is less intuitive. In addition, the knowledge map identifies areas that do not provide knowledge but rather displays what directly affects the flow of knowledge. These two different elements—knowledge sources and influences—provides knowledge regarding feedback loops. By identifying weak links and problematic variables the C2 COMCEN can take measures to improve knowledge flows.

The watch relief process affects how well knowledge transfers and how well watch-standers receive and understand the given knowledge. Because tacit knowledge is difficult to articulate, and given the amount of time it takes for a watch relief to learn, it can be assumed that little tacit knowledge exchange is possible. However, explicit knowledge and information do provide minimal situational awareness when combined with the tacit knowledge of the new watch-stander.

Figure 17 displays an example of how situational awareness cycles from the watch-stander to the relief watch-stander. The off going watch-stander retains explicit knowledge, and then over the course of the watch, acquires tacit knowledge. At the time of the next watch relief, situational awareness begins at the bottom for the new watch-stander, because he or she has no knowledge or situational awareness prior to arrival. The new watch-stander then receives explicit knowledge until he or she over time attains tacit knowledge from personal experience on watch. The cycle then repeats continuously. The challenge of the watch relief is how to smooth the knowledge cycle so that situational awareness remains at a high-level quality and is consistent from watch to watch.
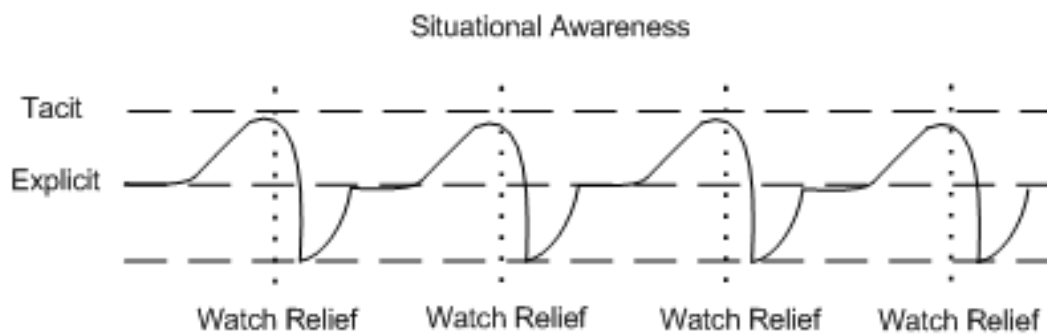
Figure 17.   Situational awareness cycle

C.   RECOMMENDATIONS

C2 COMCEN knowledge examination reveals several recommendations by watch-standers and the author to improve knowledge flows and eventually have a positive impact on situational awareness.

1.   Standardize and formalize the watch relieve process. Although watch reliefs use some standardization by providing explicit knowledge of active cases, the act of knowledge transfer is not standard thus creating knowledge gaps due to inefficiency. According to interviews, there is too much flexibility in the watch relieve process that encourages personnel to become complacent and not provide necessary details for a proper watch-relief. This becomes apparent when the new watch-stander spends up to an

75

hour after the relief analyzing available data to attain a sense or "feeling" about the active cases not otherwise provided. Several watch-standers expressed an interest in improving checklists to include tacit knowledge to force sharing of experiences. In addition, measurements to ensure high quality of a watch relief will aid in reducing knowledge degradation as discussed in the previous section.

2. Many watch-standers believe that Sectors are a rich source of knowledge, but only receive knowledge as dictated by doctrine or policy. Also, there were several complaints that Sector personnel only provide information and knowledge to the D11 COMCEN after repeated requests. In addition, the information received is not always in accordance with reporting requirements thus adding an additional burden to the D11 COMCEN personnel. The recommendation is to improve the relationship between D11 C2 COMCEN and the Sectors for knowledge flow improvements. Perhaps an exchange program between COMCENs can provide a unique experience and offer an appreciation of another's situation.

3. The manner that a watch-stander organizes their work environment impacts their management of information and knowledge. It became clear there is no standardization knowledge collection and processing. Although there are a few required forms and IT applications, several personnel lacked keeping track of watch details. Not all personnel thought the check sheets were of value and often rejected them for their own methods of documenting knowledge. Other watch-standers found IT systems the most useful method to codify knowledge while it was fresh. Still others prefer the reliance on hand written notes and memories of watch-standers and only codify it at the end of the watch. A recommendation is to provide training for all personnel on how to organize their watch position efficiently, reduce clutter, maximize information and knowledge collection, and improve knowledge codification.

4. Create a new Pacific Area watch position that monitors and assists all districts in the Pacific Area AOR. D11 COMCEN acts as the Pacific Area COMCEN when a case or incident requires it, such as when a situation crosses district AOR boarders. When such a case arises, it is at that moment that districts communicate and

76

share knowledge, not beforehand. Also noted, was the lack of standardization of knowledge between districts that create delays in situational awareness. In addition to monitoring the districts, the Pacific Area position can provide expert knowledge, assist as necessary, and ensure standardization across districts to provide real time knowledge for improving situational awareness.

5.   Improvement in the quality of trainers and training. The watch position leads need to develop training measurements to ensure all personnel receive the same comprehensive high quality training by high quality trainers. There is a consensus that not all trainers or training is equal. The study indicates that OJT influences knowledge and is critical to situational awareness.

6.   Increase watch relief effectiveness by requiring watch relief personnel to arrive early to review all active cases and activities during the previous watch. This ensures the new watch maximizes explicit knowledge and obtains tacit knowledge by "sharing" before they assume the watch. This will reduce the knowledge degradation during the watch relief process as discussed in the previous section.

7.   Implement a formal Knowledge Management Program in accordance with Commandant CG-611 requirements.

D.   FUTURE STUDY

This study provides an examination of the overall C2 COMCENs organization and its knowledge environment. It serves to identify what may influence the cause and effect relationships of the watch, understand feedback loops and identify knowledge sources that affect situational awareness. Referring to the knowledge map in Chapter IV, a study of each variable and its links may offer a guide to determine future studies. The following are recommend areas for future study.

1.   Examine the training program to improve high quality training and consistency.

2.   Examine improvements for standardizing and enforcement of checklists for cases and incidents

3.   Examine knowledge flows between the D11 C2 COMCEN and the D11 Sector COMCEN for improvement.

4.   Examine the organizations innovation process and how can new ideas be managed more effectively.

5.   Examine the impact of having MSTs assigned to the COMCEN.

6.   Examine the impact education and experience if new watch-standers spend time at other units within the D11 AOR.

7.   Examine implementing new IT systems and applications to improve knowledge storage and dissemination.

8.   Examine how the organization may codify and articulate tacit knowledge.

9.   Examine the results of implementing a formal knowledge management program.

LIST OF REFERENCES

Alavi, M., & Leidner, D. E. (1999). Knowledge management systems: Issues, challenges, and benefits. *Communications of the Association for Information Systems*, 1, Art. 7.

Alberts, D. S, & Nissen M. E. (2009). Toward harmonizing command and control with organization and management theory. *The International C2 Journal*, *3*(2).

Alberts, D., & Hayes, R. (2006). *Understanding command and control.* Command and Control Research Program (CCRP).

Ambrosini, V., & Bowman, C. (2001). Tacit knowledge: some suggestions for operationalization. *Joural of Management Studies*, 812–829.

Argote, L. (2000). Knowledge transfer: a basis for competitive advantage in firms. *Organizational Behavior and Human Decision Processes*, *92*(1), 150–169.

Bellinger, G., Castro, D., & Mills, A. (2004). *Data, information, knowledge, and wisdom.* Retrieved from Systems Thinking, http://www.systems-thinking.org/dikw/dikw.htm.

Bhatt, G. D. (2000). Organizing knowledge in the the knowledge development cycle. *Journal of Knowledge Management*, 4(1), 15–26.

Choo, C. W. (1996). The knowing organization: How organizations use jnformation to construct meaning, create knowledge and make decisions. *International Journal of Information Management*, 329–340.

Claire, A., & Brisset, B. (2000). *Knowledge modeling and management for command and control environments.* Val-Belair, QC Canada: Defense Research Establishment Valcartier.

Dalkir, k. (2002). How to stem intellectual capital loss: a three-tiered approach. *5th World Congress on Intellectual Capital Management*, January.

De Long, D. W., & Fahey, L. (2000). Diagnosing cultural barriers to knowledge management. *Academy of Management Executive*, 14(4).

Drucker, P. F. (1993). *Post-capitalist society.* New York: HarperCollins.

Edmondson, A. C. (2008). The competitive imperative of learning. *Harvard Business Review*, July–August.

Gold, A., Malhotra, A., & Segars, A. (2001). Knowledge management: An organizational capabilities perspective. *Journal of Management Information Systems*, Summer, 18(1), 185–214.

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal (Special Issue: Knowledge and the Firm)*, 109–122.

Gupta, A., & McDaniel, J. (2002, October). Creating competitive advantage by effectively managing knowledge: a framework for knowledge management. *Jorunal of Knowledge Management Practice*, October.

Hansen, M. T., Nohria, N., & Tierney, T. (1999). "What's your strategy for managing knowledge?" *Harvard Business Review*, March–April, 106–116.

Holsapple, C. W., & Joshi, K. D. (2000). An Investigation of factors that influence the management of knowledge in organizations. *Journal of Strategic Informations Systems*, 235–261.

Horvath, J. A. (2000). *Working with Tacit Knowledge.* IBM Institute for Knowledge Management. Retrieved from http://polaris.umuc.edu/mts/TMAN/TMAN_636/articles/tacitk.pdf

Horvath, J. A., Sternberg, R. J., Forsythe, G. B., Sweeney, P. J., Bullis, R. C., Williams, W. M., … et al. (1996). *Tacit Knowledge in Military Leadership: Supporting Instrument Deveopment.* Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Huber, G. P. (1991). Organizational learning: the contributing processes and the literatures. *Organizational Science*, 2(1). 88–115.

Ibrahim, R., Shumate, M., Levitt, R., & Contractor, N. (2006). *Discontinuity in organizations: knowledge flow behaviors in sequential workflow processes.* (Paper, Universiti Putra Malaysia) Retrieved from http://www.kmtalk.net/IbrahimLevittRamsey%5B1%5D.pdf

Johnson, B., Lorenz, E., & Lundvall, B.-A. (2002). Why all this fuss about codified and tacit knowledge? *Industial and Corporate Change*, 11(2), 245–262.

Lam, A. (2000). Knowledge, organizatinoal learning and societal institutions: an integrated framework. *Organization Studies*, 21(3), 487–513.

Lieberman, M. D., Jarcho, J. M., & Satpute, A. B. (2005). Evidence-based and intuition-based self-knowledge: an fMRI study. *Journal of Personality and Social Psychology*, 87(4), 421–435.

Liebeskind, J. P. (1996). Knowledge, strategy, and the theory of the firm. *Strategic Management Journal*, 17, Winter Special, 93–107.

Liebowitz, j., Rubenstein-Montano, B., McCaw, D., Buchwalter, J., & Browning, C. (2000). The Knowledge Audit. *Knowledge and process Management*, 3–10.

Lippman, S. A., & Rumelt, R. P. (1992). Demand uncertainty and investment in industry-specific capital. *Industrial and Corporate Change, 1*, 235–262.

McElroy, M. W. (2002). *The new knowledge management - Complexity, learning, and sustainable innovation.* Oxford, UK: Butterworth-Heinemann.

McGrath, James III. (2002). *Maritime Homeland Defense Command and Control: What is the Right Arrangement?* (Paper, Naval War College) Retrieved from http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA401132.

Nissen, M. E. (2001). *Facilitating Naval Knowledge Flow.* Monterey, CA: (Report, Naval Postgraduate School) Retrieved from http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA393775.

Nissen, M. E. (2002). An extended model of knowledge-flow dynamics. *Communications of the Association for Information Systems*, 8, 251–266.

Nissen, M. E. (2006). *Harnessing knowledge dynamics.* Hershey: IRM Press.

Nissen, M. E. (2007). Knowledge management and global cultures: elucidation through an institutional knowledge-flow perspective. *Wiley InterScience*, 211–225.

Nissen, M. E., Kamel, M., & Sengupta, K. (2000). Integrated Analysis and Design of Knowledge Systems and Processes. *Information Resources Management Journal*, 13(1): January-March, 24–43.

Nonaka, I. (1991). The knowledge-creating company. *Harvard Business Review*, Nov-Dec, 96–104.

Nonaka, I., & Konno, N. (1998). The concept of 'ba' building a foundation for knowledge creation. *California Management Review*, 40(3).

Pigeau, R., & McCann, C. (2002). Re-Conceptualizing Command and Control. *Canadian Military Journal*, Spring, 53–64.

Porbst, G. F. (1998). Practical knowledge management: a model that works. *Prism*, Second Quarter, 17–29.

Porter, M. E. (1980). *Competitive strategy.* New York: The Free Press.

Rowley, J. (2007). The wisdom hierarchy: representatinos of the DIKW hierarchy. *Journal of Information Science*, 163–180.

Schulz, M. (2001). The uncertain relevance of newness: organizational learning and knowledge Ffows. *Academy of Management Journal*, 44(4), 661–681.

Smith, E. A. (2001). The role of tacit and explict knowledge in the workplace. *Journal of Knowledge Management*, 311–321.

Sterman, J. D. (2000). *Business dynamics - Systems thinking and modeling for a complex world.* Boston: Irwin MacGraw-Hill.

United States Coast Guard. (2007). *United States Coast Guard Command Center Manual (CCM), COMDTINST M3120.20.* Washington DC: Commandant, U.S. Coast Guard.

United States Coast Guard. (2009). *U.S. Coast Guard: America's Maritime Guardian, Publication 1.* Retrieved from http://www.uscg.mil/doctrine/CGPub/Pub_1.pdf.

United States. Coast Guard. (2012). *National Search and Rescue School.* Retrieved from http://www.uscg.mil/tcyorktown/ops/sar/default.asp.

Watts, R. B. (2005, Volume I Issue 2). Maritime Critical Infrastructure Protection: Multi-Agency Command and Control in an Assymmetric Environment. *Homeland Security Affairs*, p. Article 3.

Weick, K. E. (1979). *The social psychology of organizing.* Thousand Oaks, CA: Sage Publications.

Wiig, K. M. (1997). Knowledge management: where did it come from and where will it go? *Expert Systems With Applications*, 13, No 1, 1–14.

Zeleny, M. (2006). Knowledge-information autopoietic cycle: towards the wisdom systems. *Int. J. Management and Decision Making*, 7(1).

Zeleny, M. M. (1987). Management Support Systems: Towards Integrated Knowledge. *Human Systems Management*, 59–71.

APPENDIX A. KNOWLEDGE AUDIT INTERVIEW QUESTIONS

		Knowledge Audit Steps
1.	A.	Determine existing and potential sinks, sources, and constraints in the organization including environmental factors that could influence the organization.
	B.	Identify and locate explicit and tacit knowledge in the targeted area.
	C.	Build a knowledge map of the flow of the knowledge in the targeted area.
2.	A.	Perform a gap analysis to determine what knowledge is missing to achieve business goals.
	B.	Determine who needs the missing knowledge.
3.		Provide recommendations from the knowledge audit to management regarding the status quo on possible improvements to the knowledge management activities in the targeted area.

		Step 1. Identify what knowledge currently exists in the targeted area
1.		List specifically the categories of knowledge you need to do your job.
2.		Which categories of knowledge listed in question 1 are currently available to you?
		For each category of knowledge you specified in question 1...
3.		how do you use this knowledge? Please list specific examples.
4.		From how many sources can you obtain the knowledge? Which sources do you use? Why?
5.		Decide yourself, who else might need this knowledge?
6.		How oftn would you and others cited in question 5 use this knowledge?
7.		Who are potential users of this knowledge who may not be getting that knowledge now?
8.		What are the key processes that you used to obtain this knowledge?
9.		How do you use this knowledge to produce a value added benefit to your organization?
10.		What are the environmental and or external influences impacting this knowledge?
11.		What would help you identify, use or transform this knowledge more effectively?
12.		Which parts of this knowledge do you consider to be (A) and excess/abundance, (B) sparse and (C) ancient/old/outlived its useful life?
13.		How was knowledge currently being delivered? What would be a more effective method for delivering knowledge?

14.		Who are the experts in your organization housing the types of knowledge that you need?
15.		In what form is the knowledge that you have gained from the experts?
16.		What are the key documents and external resources that you use or would need to make your job easier?
17.		What other types of knowledge that she will need as a daily part of your job (A) in the short term (1 to 2 years) and (B) the long-term (3 to 5 years)?

		Step 2 identify what knowledge is missing in the targeted area
1.		1. What categories of knowledge do you need to do your job better?
2.		2. What categories of knowledge do you reuse? Are there other instances where knowledge is not typically reused, but reuse would be helpful?
		For each category of knowledge you specified in question 1.
3.		3. To what degree could you improve your level of performance by having access to all the knowledge cited the question one?
4.		4. Who were what might serve as potential sources of this knowledge?
5.		5. What types of questions do you have to which you cannot find answers?
		For each type of knowledge listed in question 5.
6.		6. Of the knowledge that is missing, which types are related to: (A) job performance, (B) competitive advantage of the organization, (C) possibly lead to future expansion of the organization or (D) simple ministry of questions?
7.		7. What departments/people did you think would answer your questions but did not?
8.		8. In what areas do fine just of asking the same types of questions repeatedly? 9. Who has asked questions that you are aware of that have not been answered? And what department of a work? What level are they?
9.		10. What people/departments have contacted you for information?
10.		For each person/department listed in question 10.
11.		11. What level in the organization is each requester?
12.		12. Is the requester a new employee (less than one year), a medium term employee (1 to 3 years) or long-term employee (over three years)?

13.		13. Other questions that you been asked by others in the organization, what knowledge was requested that you consider to be (A) essential for business performance, (P) essential for the company's competitive advantage, (C) important for leading to innovations and new business areas in the future and (D) outdated and no longer useful for the business?
14.		14. What mechanisms might be helpful for encouraging knowledge sharing and transfer and your organization?
15.		15. Which aspects of your organization seems to provide barriers to effective knowledge management such as what constraints and Pete knowledge sharing and transfer?
16.		16. What are the main reasons that you could have made errors/mistakes on the job?
		If your organization has considered outsourcing in the last five years:
17.		17. In what areas was a outsourcing considered?
18.		18. If outsourcing was rejected, why?
19.		19. If outsourcing has taken place, why?
20.		20. How much time do you spend looking for knowledge?
		(Leibowitz, J., Rubinstein-Montano, B., McCaw, D., Buchwalter, J., and Browning, C.,2000)

85

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX B. KNOWLEDGE AUDIT SURVEY QUESTIONS

1. How do you rate the collaboration between employees where you work?

2. How do you rate the encouragement for innovation where you work?

3. How do you rate employee recognition where you work?

4. How do you rate the level of mutual trust between employees where you work?

5. How do you rate the availability/access to specialty experts where you work?

6. How do you rate the level of knowledge from the specialty experts where you work?

7. How much previous required knowledge did you have before reporting to this job?

8. How do you rate the usage of information technology systems for managing knowledge where you work?

9. How do you rate the level of sharing information where you work?

10. How do you rate the level of sharing job related experiences where you work?

11. How do you rate the training you received when you first reported to the unit?

12. How do you rate the availability of additional job related training?

13. How adequate is the training you received to perform your required duties?

14. Rate the availability of the knowledge you need to access to perform your job.

15. How freely is knowledge disseminated from specialty experts where you work?

16. Of the knowledge that is available to you, how useful is it to perform your duties?

17. In which area of your job do you feel you need to obtain more knowledge?

18. What would you suggest to improve knowledge flows or learning where you work?

19. How would you rate the effectiveness of your unit's Knowledge Management Program?

20. How adaptable is your work place to handling changes?

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1.   Defense Technical Information Center
        Ft. Belvoir, Virginia

2.   Dudley Knox Library
        Naval Postgraduate School
        Monterey, California

3.
        Professor Mark E. Nissen (Code SBPP/Ni)
        Naval Postgraduate School
        Monterey, California

4.   Chair, Department of Information Sciences
        Dr. Dan Boger
        Naval Postgraduate School
        Monterey, California

5.
        Commandant (CG-095)
        U.S. Coast Guard Headquarters
        Washington, DC